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Edited by
J. A. MALLETT

Articles which appear in the Journal may be reprinted, provided that both the Journal and the authors are acknowledged.

COVER PICTURE

A MEMORY OF SPRING-TIME

At a time when grey skies and rain-clouds are by no means unwelcome, here is a souvenir of a sunny September day near Geraldton. The papery pink petals of the everlasting flowers plus a pretty girl make an attractive picture

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AUTUMN LAMBING *MEANS* AUTUMN FEEDING

By C. J. SPENCER, B.Sc. (Agric.), Sheep and Wool Adviser, Katanning

MANY Merino flocks in the agricultural areas lamb down in the autumn months. This means that the lambs are being developed and reared when paddock feed is at its worst, and this in turn means that a well-planned supplementary feeding programme is essential.

It is generally realised that more feed gives a better lamb crop, but supplementary feeding costs money and it is always a difficult problem to determine just how much extra feeding a farmer can afford to give without making those extra lambs cost more than they are worth. It is obviously important to be able to make the fullest possible use of the feed that is available.

The answer to the problem lies largely in knowing the limitations of our annual-type pastures and how the needs of the breeding ewe vary. A feeding programme based upon this knowledge can be easily adjusted to meet current conditions.

THE PADDOCK PATTERN

The feeding programme must be closely related to both the quantity and the quality of the feed available.

The autumn months are marked by a declining bulk of feed. The extent of this decline is largely determined by the balance between pasture production and the number of stock carried. The need to offset this decline is usually seen and well realised by the good stockman.

Less easily observed is the fall in quality or value of the feed. The best will have been eaten during the summer months leaving a meagre ration for the increasing demands of the ewe.

THE NEEDS OF THE EWE INCREASE

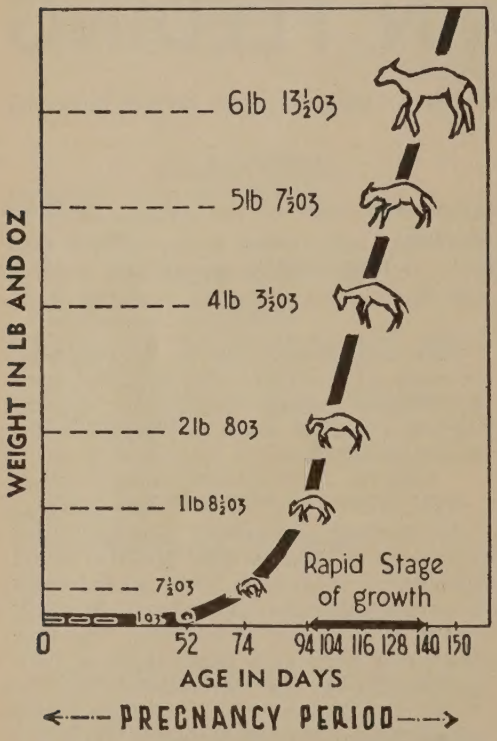
As lambing approaches, the ewe must receive extra feed to meet the increasing demands of pregnancy. This can be partly met from body reserves but must be largely met by an increased feed intake. Furthermore, this extra feed needs to be of high quality, because the ewe which is feeding on low quality feed such as dry grass just cannot digest enough to obtain sufficient nutrients for itself and the unborn lamb. Body reserves are not fully suitable nor can they be mobilised rapidly enough to supply these needs.

The position is accentuated by the developing lamb. As the lamb increases in size, the ewe's stomach is less able to hold large quantities of bulky, innutritious food. It needs concentrated foods that are rich in nutrients. In the same way, overfat ewes are likely to suffer from nutritional

disorders in late pregnancy. Surplus body fat decreases the stomach size.

THE DEVELOPING LAMB

More so than with the young of most species, the developing lamb grows rapidly in the last third of pregnancy (see diagram). During this time the weight of the lamb increases from about 2 lb. to its final birth weight. This final weight is largely controlled by the feed the ewe receives at this time. Countless trials have



shown this. Conversely the feed in early pregnancy has little or no effect on lamb growth.

The best weight for the newborn lamb is about 8 lb. While lambs much heavier than this can be lost through difficulty at birth, far more light than heavy lambs are lost in Western Australia. Below this weight, lambs are born weak and are poorly adapted to meet the sudden and drastic changes at birth.

FEEDING FOR MILK PRODUCTION

The development of the udder like the weight of lamb, is controlled by the ewe's nutrition in late pregnancy. It is then that the ceiling to the potential milk production is set. What milk is eventually produced within this potential, is determined by the post-lambing nutrition.

A delayed onset of milk flow and poor milk supply are a frequent result of poor feeding in late pregnancy. Though not always obvious in the field this is a major factor in early lamb losses. The first drink of the newborn lamb is indeed the most important in its whole life.

EARLY LAMB GROWTH

It can be seen that adequate ewe nutrition in late pregnancy is needed to ensure a fully-developed and vigorous lamb at birth, an immediate supply of milk, and a well developed udder capable of producing plenty of milk. Postnatal nutrition determines the final amount of milk actually available to the lamb. Many trials, both in Australia and overseas, have shown that the rate of growth of the lamb during the first month of its life is almost wholly governed by the quantity of milk it receives.

It is at this stage also that most of the wool follicles start to produce fibres. Just how many of these follicles eventually produce fibres is largely determined by the feeding level of the lamb.

TWINS OR SINGLES?

Many sheep-owners still consider twin lambs are a hindrance rather than a help. Australian work has shown that with sufficient feed, the Merino ewe will produce adequate milk to rear twin lambs successfully. However, the need for feed must be realised.

A ewe bearing a single lamb needs to increase in body weight during late pregnancy. Twin-bearing ewes, however need to make considerable gains if the lambs are to be reared. One very definite point is that every lamb reared is an asset.

GRAIN OR HAY?

While paddock feed remains, supplements are only needed to supply quality feed. Grain is therefore more suitable. Roughages such as cereal hay can do little

to build up the overall diet of the ewe. They nevertheless have a valuable place in providing a substitute for exhausted supplies of paddock feed.

FREQUENCY AND METHOD OF FEEDING

Mismothering of lambs can result from hand-feeding and so ewes should not be disturbed more often than necessary. However, pregnancy toxaemia losses can occur with too long an interval between feeding times. Giving two or three days' ration to the ewe at one time is therefore considered a happy medium. The shorter interval should be used when paddock feed is in low supply.

A quiet approach to the feeding site can help in this respect. Some claim less disturbance results if the feed is taken out near dusk or at night.

Self-feeders are of doubtful value, mainly because the ewe will usually eat more than is necessary or economically sound. They should be used only when the feed supply is continuous.

Trailing of grain can be wasteful unless done on hard ground. Simple troughing made from 6 in. x 1 in. boarding is perhaps the most suitable method of feeding. especially on sandy soils. Sufficient troughing must be used to ensure all sheep can feed at the one time.

GUIDE TO QUANTITIES

To provide the balance between an increasing demand by the ewe and a decreasing supply by the paddock, the following pattern of supplementary feeding is recommended as a guide.

Until six weeks before lambing is due to commence, treat the ewes as non-breeders, i.e., only feed if paddock supplies are extremely scarce and sheep are losing weight rapidly. Then begin feeding with half a pound of grain per ewe per day. This ration can then be graded up to one pound per ewe per day by the commencement of lambing. This can be done as follows:—

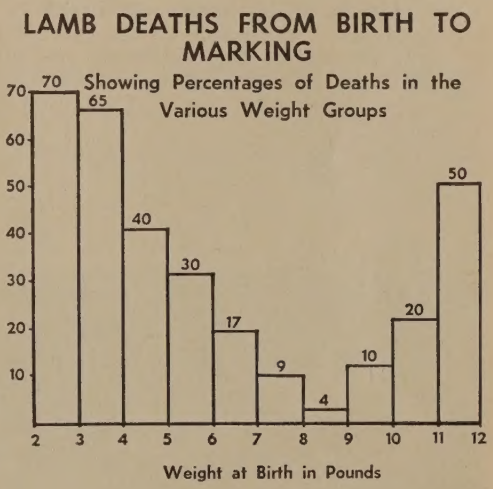
Sixth and fifth week prelambing—
½ lb. grain per ewe per day.
Fourth and third week prelambing—
¾ lb. grain per ewe per day.
Second and last week prelambing—
1 lb. grain per ewe per day.
At birth and during early lactation—
1½ lb. grain per ewe per day.

This rate needs to be continued until sufficient new season's growth is available. It should be remembered that the ewe needs even more feed during lactation than it does in late pregnancy.

No single set of rates can apply to all flocks. This pattern of feeding is however strongly recommended. Using this as a basis, the actual rates can then be modified to meet local conditions.

THE EARLY "GREEN PICK"

While it is impressive in appearance and undoubtedly valuable as a feed supplement, the early "green pick" has very definite limitations. Young vegetation is largely composed of water, and for some time has too little dry material to be of great nutritional value. The flock owner must use his own judgment here, but at least three weeks after the opening rains can be used as a guide to that time when our annual type pastures can support sheep unaided.



It should be remembered that the break of the season is the most severe part of the year. It is then that the old feed is spoilt and the new feed has yet to come.

KEY POINTS

Autumn lambing means maximum feed requirements by the ewe when paddock

supplies are at their lowest. The ewe cannot meet this demand from low-quality feed alone.

The ideal birth weight for Merino lambs is 8 lb. Adequate prenatal nutrition is important for lamb development, udder development and an early flow of milk. Postnatal nutrition, through milk production, controls lamb growth rates and maturation of wool follicles.

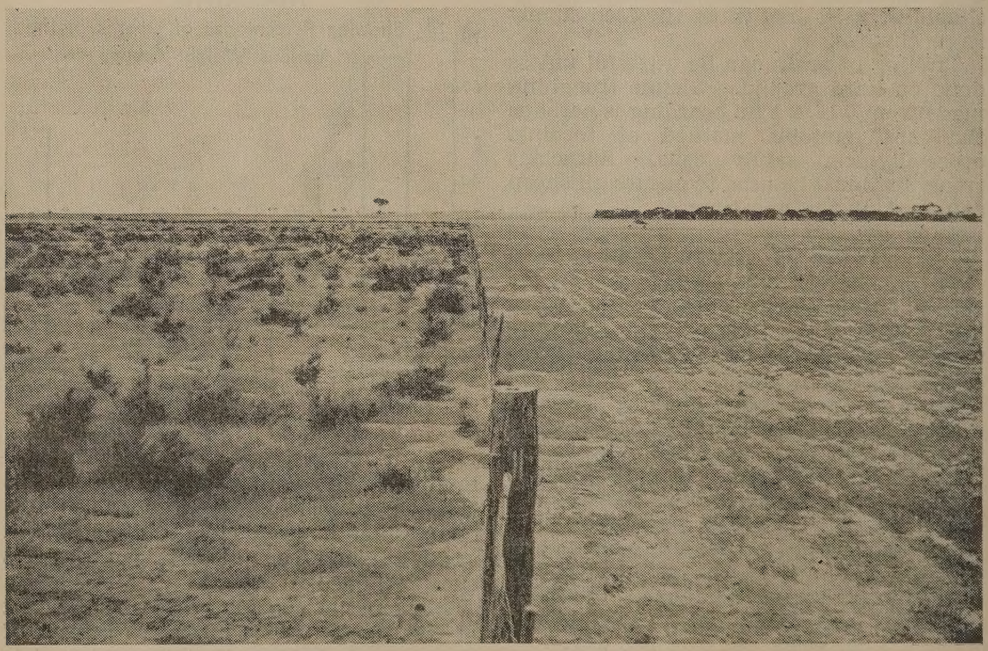
The Merino ewe can rear twin lambs.

Grain is a better supplement than hay.

The feeding pattern is just as important as the actual quantities. The following can be used as a guide:—

Until the last six weeks of pregnancy, treat the ewes as non-breeders. Then give an extra half-pound of grain per ewe per day, grading up to one pound of grain per ewe per day by the commencement of lambing. Give 1½ lb. grain per ewe per day during early lactation and until sufficient new season's growth is available.

Controlled Grazing is Essential



This photograph illustrates the importance of grazing management in allowing bluebush to establish on salt-affected land in the eastern wheatbelt. Bluebush is an extremely salt-tolerant productive perennial and while well-grown plants are able to withstand quite heavy stocking, grazing protection is essential to allow establishment.

Studies IN THE MULGA PASTORAL ZONE

THE GRAZING OF Wandarrie Grass Associations

By D. G. WILCOX, B.Sc. (Agric.), Agricultural Adviser, Wiluna.

THE establishment of the Wiluna office of the North-West Branch marked the commencement of a series of investigations into the pastures of the mulga zone. Unlike the agricultural areas where a fund of knowledge exists on the growth habits of the pastures, the pastures of this area were completely unknown. The preliminary investigations had to be aimed at forming an understanding of the reactions of the various plants to rain, to temperature and seasonal conditions and to grazing in an area of extremely low rainfall reliability.

The problem which faces the pastoralist is how to achieve maximum use from the range of vegetation available, under all conditions of rainfall, especially in those years of less than average rainfall which occur very frequently.

The experimental work carried out has led to a better understanding of some of these pastures and in particular their reactions to periods of low rainfall. It is with the Wandarrie grass associations that this article will deal.

Fig. 1.—A degenerate Wandarrie association

DESCRIPTION OF THE ASSOCIATIONS

Wandarrie grasses occur over most of the deeper and sandier soils of the mulga zone. In the ungrazed state the association consists of an upper storey of trees, a middle storey of shrubs and a ground storey of perennial tussocky Wandarrie grasses.

The Wandarrie grasses are: Broad Leaf Wandarrie, (*Danthonia bipartita*), Creeping Wandarrie (*Eragrostis lanipes*) and two Wire Wandarrie grasses (*Eragrostis eriopoda* and *Eriachne helmsii*). These four species occur with the annual Windgrass (*Aristida arenaria*) and form the bulk of the feed available to the sheep. During periods of winter rainfall alone, such plants as Mulla-mulla (*Ptilotus* spp.) and Crowfoot (*Erodium* sp.) can replace Windgrass as the annual species present.

consequently been continuously and preferentially grazed by the sheep. So much so that the associations are generally unproductive. In many cases the trees have been killed, the shrubs have been eaten out and the grass cover consists mainly of Windgrass and Wire Wandarrie grasses. Both these species are undesirable in a pasture since they are unpalatable and Windgrass in addition is low in nutritive value.

Being an annual species Windgrass is unable to respond to small quantities of rain since it must go through the processes of germination before it produces growth available to the sheep. On the other hand perennial grasses can "compete" with evaporation for water more effectively and produce some growth on quite small falls of rain—that would be indequate for a Windgrass pasture.

Fig. 2.—A fair stand of Wandarrie grasses produced after three years following enclosure. The area was very similar to Fig. 1 at the time of fencing

The relatively deep soils of the Wandarrie associations provide adequate storage of water for use by the plants in their growing period. In this respect they are superior to the remainder of the mulga scrub in which the shallow soils commonly encountered are unable to store sufficient water for vigorous plant growth.

This greater water storage ability of the Wandarrie soils has permitted more growth in the association and they have

This distinction between annuals and perennials has helped in the evaluation of the relative worth of the different species of the association.

The experiments described below detail initial investigations into these pastures. The observations made enabled grazing trials to be undertaken from which recommendations for the rehabilitation of these pastures can be made.

The following initial experiments were carried out:—

(a) The Effect of Enclosure on a Wandarrie Association.

Ten acres of degenerate Wandarrie country were sheep, cattle and vermin-proof fenced in 1956.

An assessment of the composition of the grass pasture was made using the step point method and the three step point method. Of the plants present, Windgrass represented over 70 per cent., Broad Leaf Wandarrie 8 per cent. and Creeping Wandarrie 13 per cent. With only two years without grazing this ratio had changed considerably, less than 50 per cent. of the plants present were Windgrasses, Wire Wandarrie grasses made up about 5 per cent. and Broad Leaf and Creeping Wandarrie grasses made up about half the pasture available.

Since the mulga zone has a tendency towards winter rainfall dominance, the pastoralist should be able to recognise this feature in his pastures.

The seeding habits of each species were also different. All species seeded with summer rains. Both the useful species needed a period of vegetative growth before maximum seed set took place. This vegetative growth period was at least ten weeks, or until the water supplies in the soil were nearly depleted. On the other hand Windgrass and Wire Wandarrie grass were able to set seed and grow vegetatively immediately after a rain.

Response to winter rain in all species was the same. Seed set accompanied leaf growth immediately after the rain. Seed production of the Wire Wandarrie grasses under these conditions was very low and in amount comparable to the low vegetative growth.

Fig. 3.—Broad leaf Wandarrie *(Danthonia bibartita)*. This plant has seeded

At the same time useful observations were made on the habits of the grasses.

All the grasses needed a summer rain to germinate but their reactions to winter rain varied. Broad Leaf and Creeping Wandarrie grasses were able to grow actively and set seed with winter rain. This activity was also extended to Windgrass. The Wire Wandarrie grasses were unable to make use of these winter rains to the same extent. A pasture consisting mainly of this species would contribute very little for sheep with winter rain.

It is obvious that if regeneration of the desirable grasses is to take place, then grazing management should take into account these variations in plant behaviour. Unrestricted grazing will result in severe depletion of the seed supplies and in time will cause a decrease in the number of desirable species.

(b) The Effect of Cutting on the Production of Wandarrie Grass.

Since seed supplies are vital to the regeneration of the grass associations it was

necessary to observe in some detail the effect of grazing upon subsequent production of the species in the association. This trial was limited in the first instance to Broad Leaf and Creeping Wandarrie grasses.

Broad Leaf Wandarrie grass when cut, used the available moisture for vegetative growth with the complete exclusion of seed production. Creeping Wandarrie grass, however, did attempt some seed production as well as vegetative growth after cutting.

Heavy grazing could therefore restrict the build up of seed supplies if the plants are grazed before seed has been dropped.

This marked palatability of Broad Leaf and Creeping Wandarrie grasses will influence the grazing management of these associations.

These three trials have furnished information which can be used to form the basis of a sound management programme for Wandarrie associations in a deteriorated condition. The reactions of the components of the association to rain are known in terms of vegetative growth, seedling establishment and seeding habits. The relative worth of each species has been determined by its reaction to the seasonal incidence of rainfall, its palatability and, in case of Windgrass, its fodder

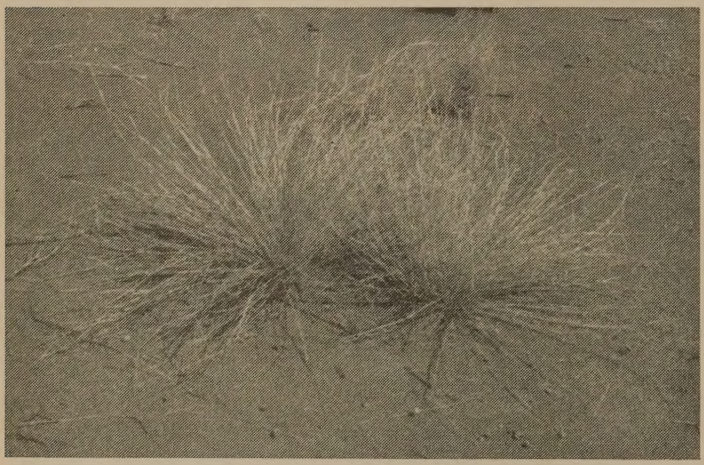


Fig. 4. — Two Creeping Wandarrie plants *(Eragrostis lanipes)*. Without grazing these plants tend to grow more upright as in the photograph

(c) The Relative Palatability of the Wandarrie Grasses.

A complete record was made of the plants occurring within a small enclosure. Five sheep were introduced and their grazing preferences observed closely over five days. After grazing the plants were rated for palatability which was taken to be directly proportional to the amount of the material eaten.

Broad Leaf and Creeping Wandarrie grasses were highly palatable at all stages of growth. Every seedling of these species was removed by the end of the grazing period.

The Wire Wandarrie grasses and Windgrass were not grazed at all.

value. The effect of grazing upon seed production is known and the susceptible phases of the growth cycle have been discovered.

Since both Broad Leaf and Creeping Wandarrie grasses respond to summer and winter rain, are perennials and are highly palatable, they should be fostered in the association.

Wire Wandarrie grasses and Windgrass should be discouraged since they are both unpalatable and are unable to use all the rainfall received to best advantage.

The management programme should be designed to allow the desirable grasses to become established and to set seed before being grazed. This will allow a seed reserve

to be built up and also permit root reserves to be made as a protection against drought.

Grazing trials already in progress have shown that this method of approach is sound. In contrast with an area under paddock grazing conditions, Broad Leaf and Creeping Wandarrie grasses have maintained themselves under controlled grazing while Windgrass has declined. Normal paddock grazing in the same period has resulted in a complete removal of desirable grasses. This pasture has little to offer, whereas the correctly-grazed area is able to offer more for the animal than was possible in its previous condition.

The programme necessary for this change to be made in the pasture is based upon the seasonal incidence of rainfall.

Under conditions of summer rainfall both Broad Leaf and Creeping Wandarrie grasses need at least four months in which to complete the seed-setting process. The association should not be grazed until this has been completed. Grazing may then follow this spelling at an annual rate equivalent to that of continuous stocking.

With winter rains, seed production in Broad Leaf and Creeping Wandarrie grasses takes place rapidly. Grazing should not be permitted for at least eight weeks or until seed-set has been completed. The pasture may then be grazed at normal paddock rates.

This type of grazing management will enable degenerated Wandarrie country to recover to its normal state of high productivity. Once it has recovered it will be necessary for the pastoralist to manage it so that the desirable species remain dominant. This will involve occasional spelling and the avoidance of excessive stocking.

It may be argued that this spelling of paddocks is not possible on a station scale. On the average station, if only two paddocks are left ungrazed during the vital growing and recovery period following rain, the remaining paddocks will have their numbers increased by merely ten per cent.

The argument is also advanced that kangaroos will prevent any recovery in the pastures. In the years when these methods of rehabilitation are most effective and when they are most easily carried out, kangaroos are scattered and not present at levels where they could prevent recovery of the vegetation.

Proper pasture management rather than stock management should be the first concern of the pastoralist. For unless the pastures are preserved through attention to their requirements they will deteriorate to the point where stock management is impossible.

ACKNOWLEDGMENTS

I would like to acknowledge the assistance that has been given to us by Mr. E. H. Lee Steere and the Belele Pastoral Company in conducting this work.

I would like to thank Mr. C. J. Henderson of Belele for his ready assistance and for his advice which has helped us considerably.

The tedious field work connected with the investigations was lightened considerably by the assistance of Mr. J. G. Morrissey and Mr. B. W. van der Loos.

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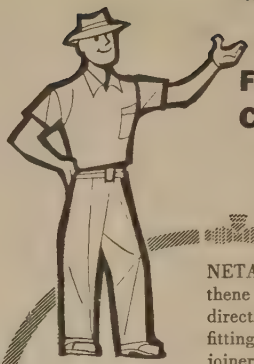

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INSECT PESTS

Insects and Mites Found Attacking Cereal Crops in Western Australia

By C. F. H. JENKINS, M.A., Government Entomologist

ONE of the most important factors influencing Western Australian agriculture in the last 20 years has been the development of permanent pastures together with the associated practice of ley farming. Although the increased use of pasture plants, and particularly subterranean clover, has increased the general fertility of many areas it has also accentuated various problems, including those relating to insect control. Summer fallow was a strong deterrent to such pests as the red-legged earth mite, the lucerne flea, and webworm and these and several other creatures have shown a tendency to increase under new farming methods.

In most cases however, suitable counter measures are available although their effectiveness depends upon an accurate knowledge of the particular pest concerned and the thoroughness with which the actual treatments are applied.

The following list includes the best known pasture pests of the agricultural areas:—

The Red-legged Earth Mite *(Halotydeus destructor)*.
The Lucerne Flea *(Smynthurus viridis)*.
The Small Plague Grasshopper *(Austroicetes cruciata)*.
The Webworm *(Talis pedionoma)*.
The Southern Army Worm *(Persectania ewingii)*.
The Climbing Cutworm *(Heliothis punctigera)*.
The Brown Looper *(Ciampa arietaria)*.
The Day Flying Moth *(Apina callisto)*.
Cockchafer Beetles—
(? Colpochilodes sp.)
(? Heteronyx sp.).
The Black Cricket *(Acheta commodus)*.
Cereal Aphis *(Rhopalosiphum maidis)*.
False Wireworm *(Cestrinus punctatissimus)*.

Fig. 1.—Red-legged earth mite (greatly enlarged)

LUCERNE FLEA AND RED-LEGGED EARTH MITE

Extensive research on these two pests has been carried out by officers of the C.S.I.R.O., over the past twenty odd years. Many of the findings which follow are a result of this work and, particularly, of investigations carried out by Mr. Murray Wallace who is still working on these problems.

Damage to Pastures. Attack by the red-legged earth mite has been shown to affect improved pastures in three ways. Firstly, the total amount of growth in the pasture may be substantially reduced. For example, in a newly established subterranean clover pasture, the yield of clover may be reduced by as much as 85 per cent. and the total yield of pasture by up to 30 per cent. depending upon the composition of the pasture. In established pastures under grazing conditions the differences are not so great but on the average, effective mite control has increased yields by about 14 per cent. Another response to control measures, is a change in the botanical composition of the pastures. The proportion of clovers and grasses is increased whilst there is a corresponding decrease in the amount of capeweed. The significance of this change is at present unknown. Finally, reports from many districts and our own observations in experimental areas show that both sheep and cattle have a strong preference for treated pastures. This response has been observed using different insecticides and irrespective of whether it was the flea or the mite which was being controlled. Again the significance of this apparent change on palatability is not known. (Comparable details have not been worked out for lucerne flea damage but the trends would probably be comparable to those cited for the red mite.)

There is thus ample evidence to show that fewer mites and fleas result not only in a greater bulk of pasture, but apparently also in one which is more palatable and of a slightly different, although not necessarily better, composition.

Cost of Control Treatments. Despite these sometimes substantial effects of mite and flea attack, the evidence available seems to suggest that the difference between cost of treatment and financial gain may vary greatly from year to year and from property to property. Costs of treatment must, therefore, be maintained at as low a level as possible.

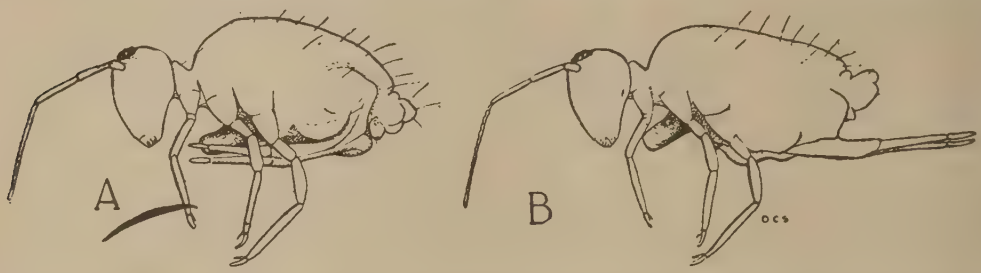


Fig. 2.—Lucerne flea showing the operation of the "spring." In A, the spring is folded in the normal position. In B, it is extended after jumping

Possibility of Eradication. It is important to realise that with the methods at present available, eradication of these pests is not feasible, and in fact is, to all intents and purposes, impossible. This is important because there seems to be a tendency among farmers to spray large areas of land apparently in the hope that by covering such a large area, all fleas and/or mites within the sprayed zone will be eliminated and movement in from outside will be negligible. Unfortunately both these pests have great powers of multiplication and large numbers can quickly develop from the few survivors which will certainly remain after treatment.

Timing of Control Treatments. It has been shown very clearly, at least in the case of the earth mite, that the most serious damage to pastures occurs from three to four weeks following germination. Damage done later in the season, is much less

important although of course it may be quite significant.

It has often been observed by farmers that towards the end of the season, pest numbers in a sprayed paddock may be fairly high whereas numbers in a neighbouring unsprayed area may be lower than they were at the beginning of the season. Recent work by Mr. Wallace has shown that this is quite a normal happening, and that

Fig. 3.—Webworm moths (natural size)

populations which are low at the beginning of the season, tend to increase in subsequent generations whereas high initial population tend to decrease towards the end of the season. The effect of the insecticide is simply to produce a low early season population and so give crops and pastures a brief respite during which seedlings may become firmly established and so better able to withstand the attacks of their various insect enemies.

Methods of Applying Control Measures. Low-volume sprays and aircraft have been effectively used to apply materials for lucerne flea and red-legged earth mite control. The sprays should be carefully applied so that patches are not missed here and there as the pest can spread rapidly from such places and re-infest sprayed areas. Aerial treatments have given quite satisfactory results and in those instances where complaints have been investigated the reason for unsatisfactory control has usually been associated with unsuitable weather conditions at the time of spraying, difficult terrain or too low a gallonage per acre.

Frequency of Treatment. Where heavy mite and flea infestations are observed early in the season, and where obvious damage is likely to occur, control measures are fully warranted. On the other hand, the wholesale spraying of infested or lightly-infested crops or pastures as practiced by some farmers as a general preventive measure, is neither economical nor desirable.

The Use of Systemics. A number of recently developed organic phosphorus insecticides have a systemic action which renders the seed of treated plants toxic to certain types of pests. Seed treatments with various systemics have rendered clover toxic to red-legged earth mite and lucerne flea, and it is probable that similar techniques could be adapted for cereals. At the present stage however, such treatments cannot be recommended on a field scale and they have not been proved effective for caterpillars such as webworm and the army worm.

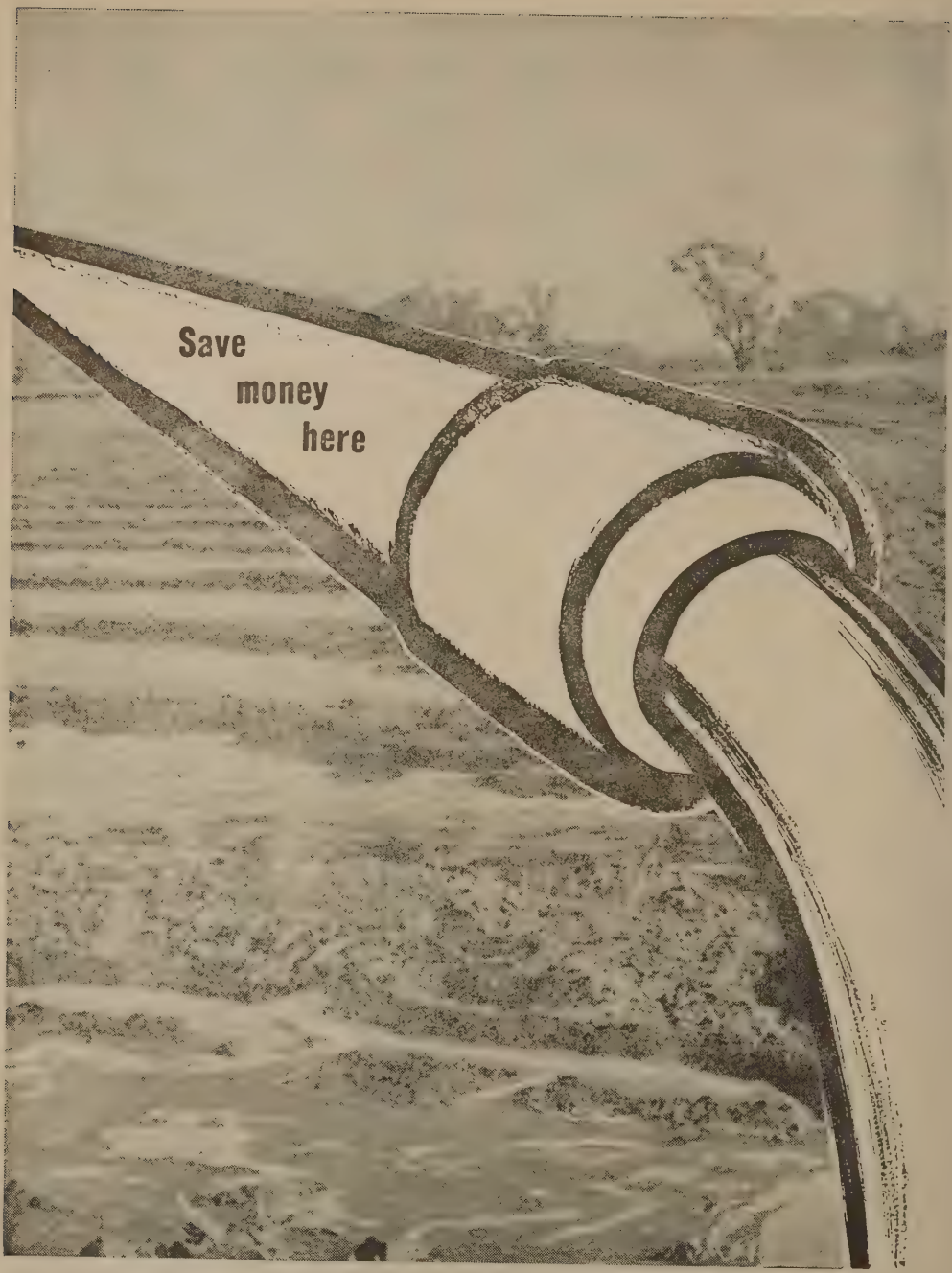
LITTLE PLAGUE GRASSHOPPERS

The chief grasshopper pest in this State is the little plague grasshopper of the eastern wheatbelt. Outbreaks are confined to the lighter rainfall areas and so damage is mainly confined to volunteer pastures and cereal crops. The fact that bad grasshopper outbreaks often coincide with poor seasonal conditions means that although

Fig. 4.—Webworm caterpillars (enlarged)

high grade pasture may not be attacked the feed which is destroyed can ill be spared and its loss may turn a moderate drought into a major catastrophe.

The little plague grasshopper is a native insect, which has been favoured by certain types of agricultural development in the outer wheatbelt. Grasshoppers have always been present in the districts in question but their breeding grounds were originally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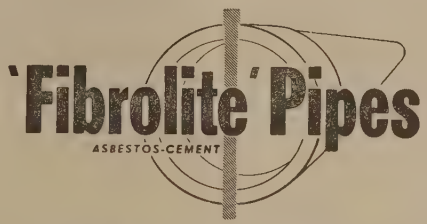

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limited to bush clearings, roadsides and other more or less restricted areas of bare, hard soil. The wide-spread clearing which was sponsored in the early financial depression of 1929 provided the grasshoppers with vast breeding grounds and precipitated the major grasshopper plagues of the nineteen thirties and early forties.

Control Measures. The extensive cultivation, under government subsidy, of grasshopper egg-laying sites, the general improvement in the status of agriculture in the outer areas and recent developments in insecticides and equipment have led to a considerable improvement in the grasshopper problem in recent years.

The use of poisoned bran bait has been almost completely supplanted by dieldrin spraying and low-volume applications, both with ground equipment and aircraft, have given excellent results. The rates recommended vary from 2 oz. to 4 oz. of dieldrin per acre.

CATERPILLARS

Various types of caterpillars may appear in plague numbers at irregular intervals. The occurrence of the insects is greatly influenced by seasonal conditions and cultural activities and the principal species will be dealt with in approximately their order of importance.

Webworm.

The webworm moth is a native insect which lays its eggs in dry stubble and pasture paddocks about mid-autumn. As grasses and cereal crops emerge following the first rains, the caterpillars commence feeding and in favourable years may cause extensive damage. The egg-laying moths are not attracted to bare ground and so fallow crops are immune from webworm damage. The increasing tendency to plough in pasture land for cereal cropping however, has created favourable conditions for webworm activity in many areas. Careful investigations have been made into the habits of the moth in order to devise suitable cultural measures which may reduce the danger of webworm attack.

It has been found that early crops are less liable to damage than late-sown crops and that where planting can be delayed a fortnight or longer after ploughing the liability of damage is further reduced. An additional cultivation before planting may also be helpful.

An aspect of the webworm problem which is often overlooked is the possible effect of the caterpillars on a balanced pasture. As the insects attack only the grasses, they may help to cause clover dominance in what otherwise would be a good mixed stand. To give some idea of the number of webworm caterpillars which can be present in an area it may be mentioned that sampling done in a barley grass paddock at Goomalling revealed a population of half a million insects per acre.

Fig. 5.—Climbing cutworm moths (natural size)

Cutworms.

Two species of cutworm moths are important pasture pests. The best known is the climbing cutworm *(Heliothis punctigera)* but perhaps the most spectacular is the southern army worm *(Persectania ewingii)*. Mass formations of these caterpillars may develop in feed paddocks and then move on a broad face into adjacent clean areas and standing crops. Mechani-

cal barriers such as trenches and deep plough furrows will retard the progress of army worms and may be employed in association with chemical dust and sprays.

The climbing cutworm is mainly a pest of legumes, and lupin, and pea-growers will be well acquainted with the depredations of the insect. Cultural methods have

Fig. 6.—Typical cockchafer beetle

little effect upon this particular species as the moths fly into the paddocks and lay their eggs on the maturing crop. Where large caterpillar populations develop, insecticide treatments are often essential.

The Day-Flying Moth.

Although this insect is of minor importance as a pasture pest and negligible as a crop pest, it has been included because the large black caterpillars of the day-flying moth are often so numerous in clover pastures as to attract the farmer's attention. They feed mainly upon capeweed and *Erodium* and only under exceptional circumstances are of sufficient importance to warrant any counter measures.

Brown Loopers.

The habits of the brown looper caterpillars are somewhat comparable to those of the army worm, for when the insects are present in large numbers they may advance in mass formation and cause heavy damage to pastures. As the popular name "looper" suggests, the caterpillars have a characteristic habit of arching their backs during progress, and this easily distinguishes the species from the more orthodox cutworms.

COCKCHAFERS

Spasmodic damage from cockchafer beetles or pasture grubs has been known in the lower Great Southern for very many years. In 1955 however, quite serious outbreaks occurred in the Kojonup-Boyup Brook zone and in 1957 the problem had further intensified.

Investigations show that possibly two species of cockchafer beetles are involved and that neither of them have similar habits to the pasture grub of Eastern Australia. The larger of the local species is probably a member of the genus *Colpochilodes* and the smaller variety has been tentatively attributed to the genus *Heteronyx*. *Colpochilodes* have the remarkable habit of flying in mid-winter and the life cycle apparently takes two years to complete. This would account for the occurrence of plagues in alternate years and the peak outbreaks of 1955 and 1957. Damage reported in 1959 was rather less than in the two previous outbreak years.

Unlike the Eastern States species, the grubs are entirely subterranean and insecticide sprays and dusts have failed to give field control. It is hoped, however, that the correct timing of these applications in relation to egg-laying and hatching may finally prove satisfactory. A detailed study of this problem has been carried out at Marradong and various further trials are planned for the coming autumn.

No practical control recommendations are yet available but insecticides (particularly dieldrin) applied in the early autumn, i.e., before egg-laying has occurred, prevented the survival of the young grubs.

The reason for the increase in cockchafer damage in recent years is not known for certain. It is probably linked with the great increase in clover pastures however,

as a similar sequence has been observed in Victoria, South Australia and Tasmania.

Many cockchafers are popularly known as dung beetles as the adults are attracted to animal droppings, and show a preference for areas rich in nitrogenous material. It is possible that the heavy stocking of clover areas plus the high soil nitrogen may provide conditions attractive to adult beetles and favourable to grub development.

BLACK CRICKETS

Black crickets have very specialised requirements and consequently can only reach plague numbers in certain restricted areas. Under favourable circumstances, however, they may develop in enormous numbers and completely denude adjacent crops and pastures. Heavy soils, subject to winter flooding and deep summer cracking, provide the best habitat for the black cricket and consequently the flats to the west of Harvey are one of the main local sources of infestation. Insecticides normally used for grasshopper control have given good results against crickets, but it is only in very limited areas that any action has been found necessary.

CEREAL APHIS

In some countries it is not uncommon for aphis to do damage to cereal crops and quite widespread infestations have occurred in Western Australia. In 1953, aphis were recorded in Mullewa, Carnamah and Goomalling and numerous complaints were received in 1959, the main reports coming from the Great Southern and districts to the east. The aphis cluster on the flag and developing cereal heads and may cause some accumulation of honey dew and sooty mould. I know of no instance where serious losses have been caused by aphis however, and control measures have so far never been warranted. Aphis may be involved in the transmission of certain virus diseases and should these gain access to the State then aphis infestation could be a much more serious problem.

WIREWORM

The larval stage tenebrionid beetle is sometimes found associated with germinating wheat crops and complaints of damage have been received from Merredin, Dumbleyung and certain other wheatbelt areas. So far damage has been very restricted, the grubs confining their attention to germinating grain. No control measures have been tested locally as the creature has not proved of sufficient importance. South Australia has reported comparable damage in recent years and Lindane - Superphosphate mixtures at planting time have proved beneficial.

TO SPRAY OR NOT TO SPRAY

There is a growing tendency amongst farmers to carry out large-scale spraying against pests as a routine measure whether

Fig. 7.—Larva of cockchafer beetle

tangible gains are assured or not. If spray treatments cost 10s. per acre then the farmer should feel reasonably sure that he will increase his return by something in excess of 10s. per acre when he sprays a crop or pasture.

The possibility of spot-spraying with ground equipment should always be considered before large-scale aerial treatments are undertaken. Quite often, a careful survey of grasshopper, red mite and lucerne flea infestations will show that the plague areas are scattered and that an overall treatment would be unnecessarily extravagant.

Even when the necessity for spray treatments has been definitely finalised, the pros and cons of ground versus aerial

spraying should be carefully considered. Under satisfactory conditions good results can and have been obtained from aerial spraying, but if the weather conditions or the terrain are unsuitable, aerial applications may prove to be very disappointing as well as expensive.

At current rates the cost of material for the control of red-legged earth mite and lucerne flea using 1 oz. DDT (¼ pint 20 per cent. concentrate) plus 1 oz. Malathion (4 tablespoonsful of 50 per cent. concentrates) is approximately 3s. 2d. per acre. Webworm control at 8 oz. DDT would cost approximately 10s. per acre.

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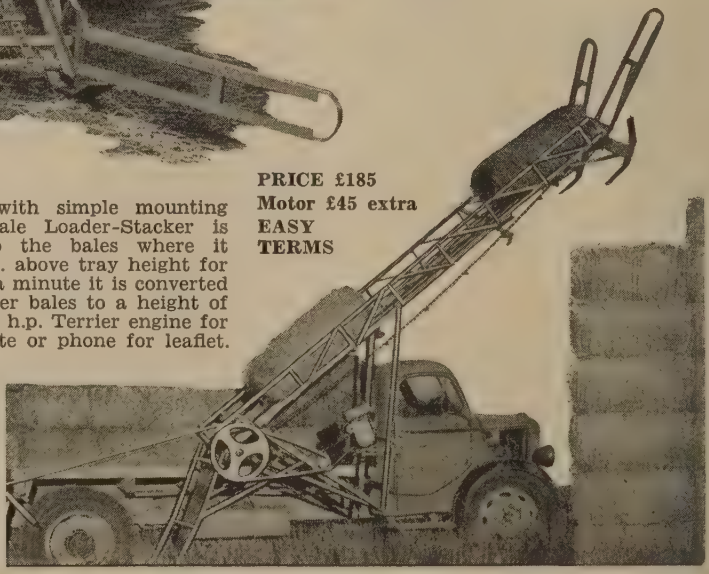

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The Problem of

LOW SOLIDS-NOT-FAT IN MILK

By L. C. SNOOK, D.Sc., Animal Nutrition Officer

(Based on a Paper read at the Annual Conference of the Australian Institute of Dairy Factory Managers and Secretaries, 19/3/1959.)

TO the consumer of milk, the solids-not-fat fractions is of prime importance. This contains the protein, the minerals and the milk-sugar which collectively make milk such a valuable and palatable food. If we wish to encourage increased consumption of milk as a health food it is essential that quality must be maintained and if possible improved. Producers and distributors must always remember that if maximum sales are to be obtained, the needs of the consumer must remain paramount.

Under present regulations, fluid milk for human consumption must contain at least 8.5 per cent. solids-not-fat. When this conventional legal minimum was established it appeared to be a generous one for the producers. In most tables of foodstuff composition, milk is listed as containing something like 8.8 or 8.9 per cent. solids-not-fat. Thirty years ago most milk was of this quality. In those days the cows which were popular in English-speaking countries in fact secreted milk which in most cases contained at least 8.7 per cent. solids-not-fat. But since the early 1940's there has been a steady decline in the percentage of solids-not-fat in the milk being made available for human consumption. Professor Kay (1956), for example, has drawn attention to the steady deterioration in the quality of the milk sold in England since World War II. Most of the milk being sold is still above the standard laid down by law but only just so. This decline in milk quality is a serious matter for the consumer in particular. What factors have operated to produce such a world-wide change in a vital foodstuff?

BREED

There is no doubt that a change in the breed which dominates the national dairy herd is the main factor. Throughout America, Britain, Australia and New Zealand, Friesians have become universally popular. And there can be no argument that Friesians **as a breed** produce milk which barely satisfies the minimum standards. British figures show that on average Friesian milk contains only 8.58 per cent. solids-not-fat. English Shorthorns are not much better with an average of 8.70 per cent. but this does give a

better margin for safety. Ayrshires are a shade better with 8.75 per cent. while the Channel Islanders average close to 9.00 per cent. In 1954, in a survey made in Gippsland, Wilson reports a similar variation according to breed.

In summertime the Friesian herds yielded milk with a range in value for solids-not-fat of 8.45 to 8.9 per cent. The bulk milk was quite satisfactory but here again the margin of safety was inadequate. In the wintertime the milk from these Gippsland Friesians fell to a range of 7.7 to 8.6 per cent. for solids-not-fat. The milk from Jersey herds showed a comparable decline during the winter months but because of the high margin of safety the bulk milk remained above standard.

The importance of breed in determining milk quality was demonstrated very clearly in an investigation carried out at Penrith, N.S.W. (Monro and Bailey, 1958). For 12 months milk samples were collected each week for analyses from pure-bred herds representative of the major breeds. All herds were situated close together and were dependent mainly on improved pasture. The Jersey herd, which averaged 2½ gallons of milk per cow daily throughout the year, never yielded bulk milk with less than 9 per cent. solids-not-fat or less than 4.4 per cent. butterfat. The Guernsey herd with an average daily yield of three gallons, on one occasion (when feed was scarce) produced milk containing only 8.5 per cent. solids-not-fat. The bulk milk, however, was never below standard. In contrast, both the A.I.S. and Friesian herds produced sub-standard milk when feed was in short supply.

No one disputes this breed factor. Many dairymen have already taken positive action to correct the position. Stud-breeders are sorting out strains within the Friesian breed which have an inherent capacity to produce milk reasonably high in solids-not-fat. Genetical studies indicate that high milk production and better-than-average solids-not-fat can be combined and transmitted to progeny. Meantime for immediate correction of a solids-not-fat problem Channel Island cattle are being introduced into Friesian and A.I.S. herds. In some cases, however, it may be necessary to add 30 per cent. of Channel Islanders to a herd of productive Friesians in order to make sure the milk never falls below standard. One can forgive a lover of Friesians for hesitating to make such a drastic change as this.

Some wholemilk producers have set out to improve the position by using high class Jersey or Guernsey bulls on their Friesian cows. Excellent first-cross heifers have been obtained this way. In fact considerable experimental evidence is now being accumulated which shows that dairy cows from pure-bred mothers but sired by bulls of another breed in general produce significantly more than their dams or pure-bred half-sisters.

At present the breeder who sets out to establish blood lines in which milk production and solids-not-fat are both dependable, is handicapped because it is not usual to test the milk of individual cows for solids-not-fat.

It is conceded, of course, that where the butterfat content is high, so also in general will be the solids-not-fat. More definite information about solids-not-fat values is needed, however, by the breeders of Friesians in particular. Given this information there is no doubt that full use will be made of families with an inherited capacity to produce heavy yields of good quality milk.

FEEDING

Emphasis has been given to the importance of breed in determining the quality of milk because there has been a tendency for those in control to ignore or side-step the obvious. When it comes to helping the dairy industry, however, it is probable that an understanding of the importance of feeding will be of more immediate value. Changes in breeding practice can only be of help in future years, whereas correct feeding can do much to eliminate the problem right now.

For many years it was taken for granted that the quality of a cow's milk was determined by the breeding of the cow. To a certain degree this is true. If a cow which normally produces rich milk is starved, it produces less milk rather than milk of poorer quality. But we now know that feeding practice can also have an important effect on quality. A classic example is the fall in butterfat content which occurs when the cow's ration is deficient in roughage. In a similar manner it has

been shown that lack of readily available energy can cause a significant fall in the solids-not-fat fraction. Extensive research has been carried out overseas, particularly by the National Institute of Dairy Research at Reading in England. It has been shown (Bailey, 1952) that the solids-not-fat fraction of milk varies directly with the intake of energy (starch equivalent) and inversely with the dry matter. In other words a shortage of readily digested energy food can produce a fall in the percentage of solids-not-fat as well as a fall in yield. Likewise, if a ration becomes too bulky, i.e., it contains too much roughage, this can depress the solids-not-fat fraction in the milk. Of further interest is the fact that a lack of energy in the ration can cause a more marked fall in the protein content of the milk than will a lack of protein in the diet (Kay, 1950).

The research findings fit in very well with practical observations. It is significant that a depression in the solids-not-fat fraction of commercial milk occurs during those seasons of the year when feed is scarce and the cows are falling in condition. For example, on non-irrigated farms, trouble is seen towards the end of summer when the dry feed is of little value and hay is fed in large amounts. With the advent of rain and green feed the problem disappears. In contrast, on irrigated farms the depression in solids-not-fat is seen **after** the rains when the growth of pasture on low lying land is very slow, and hay again becomes an important item of diet. Incidentally I always associate a solids-not-fat problem with a lean herd, or at least with a herd where the top cows are lean.

Where milk is being produced which is low in solids-not-fat, the recommendations can be simple and clear cut. Palatable, readily-digested, high energy supplements must be fed at a generous level. Crushed cereal grains, pollard and commercial dairy meals all appear to be effective. In most cases the increase in the concentrate ration has a dramatic effect in improving milk quality and milk yield. Farmers who hesitated to provide this extra feed because of the costs involved have admitted that the increased yield paid for the extra feed. The main object, of course, is to tide the herd over a period of food shortage during which there is a risk of prosecution for selling sub-standard milk.

My only variation from what will be accepted as orthodox advice is to stress the importance of phosphatic supplements, particularly to cows on dry feed. In Western Australia it is also important to make sure that adequate cobalt is consumed. It is vital that dairy cows should have robust appetites and adequate cobalt is essential to maintain this appetite. It is of more than passing interest that areas affected with marginal deficiencies of cobalt are more extensive than formerly was considered to be the case.

Excessive roughage can cause a fall in solids-not-fat chiefly because roughage reduces the cow's capacity to ingest high energy food. Those who have followed Professor Boutflour will remember that he obtained fantastic production by feeding the maximum amount of concentrates and the minimum amount of roughage to Friesian cows. It is not surprising that milk from many of his "gun" cows contained only the minimum of butterfat but the Professor made no secret of the fact that he had no intention of supplying any more butterfat than he was paid for. I know nothing of the solids-not-fat content of the milk produced but no doubt every care was taken to see that it was above standard. The use of high energy, low fibre rations would be expected to produce milk with better-than-average solids-not-fat.

Breeding and feeding are the two variables of most importance in determining the solids-not-fat content of milk. Other factors are of minor significance but should be mentioned.

DISEASE

When a cow becomes infected with mastitis the milk becomes abnormal and may be deficient in solids-not-fat. Likewise, in metabolic diseases which reduce yield, the milk tends to become sub-standard. One would expect this, of course, because in ketosis or acetonemia the fall in milk yield is due to starvation, that is, to a lack of the readily digestible food which is so important if milk quality is to be maintained. It is generally accepted, however, that disease is unlikely to become sufficiently prevalent in any one herd, to affect the quality of the bulk milk.

SEASON

The decline in solids-not-fat is generally seasonal. Here again it is the level of feeding which produces the change rather than the actual climatic conditions. All over the world disturbing falls in solids-not-fat occur during that season of the year when nutrition is at the lowest ebb. This in itself seems to confirm the opinion that with herds close to the borderline the supply of palatable food as such can be of prime importance in maintaining solids-not-fat at the required level.

STAGE OF LACTATION

The solids-not-fat content of milk varies with the stage of lactation and the age of the cow. Here again the variations are not likely to affect the quality of bulk milk. The solids-not-fat content in general is at a minimum about a month after calving. Likewise, cows producing at their peak in the prime of life (say six years of age) tend also to reach their minimum as regards percentage of solids-not-fat. Possibly if a farmer has a lot of mature cows calving together the quality of the milk could show a significant decline but this could only be of consequence in a herd where the general average was close to minimum requirements.

There can be a marked variation in the percentage of butterfat in morning and evening milk, where there is a difference in the intervals between milking. In general, however, the percentage of solids-not-fat does not vary. Certainly it is no solution of a solids-not-fat problem to mix morning and evening milk.

GENERAL

During recent years there has been a decline in the solids-not-fat content of the milk which has been available for human consumption. Because this decline has been so general suggestions have been made that the official standards laid down by the Health Act should be relaxed. It is well to remember, however, that milk holds its place as a valuable food because of the goodness it contains. In addition, much of the attractive flavour is due directly to the solids-not-fat fraction. In fact, the producers of wholemilk could quickly lose business by agreeing to a reduction in standards. Discerning housewives are already using increasing quantities of dried milk powders as substitutes for natural milk. The realistic way to counter this trend is to improve the quality of the fresh milk so that the purchaser obtains better value, rather than less.

It is apparent from the facts presented in this article that with correct breeding and feeding practice, the dairy industry **could** produce milk which is richer in solids-not-fat. Unfortunately the dairy farmer is paid no more for rich milk than for milk which just satisfies the legal requirements. It follows that the profitable cows are those which produce a lot of milk rather than those which produce rich milk. It seems, therefore, that consideration should be given to the merits of contracts under which producers of milk for human consumption are paid according to the quality of the product.

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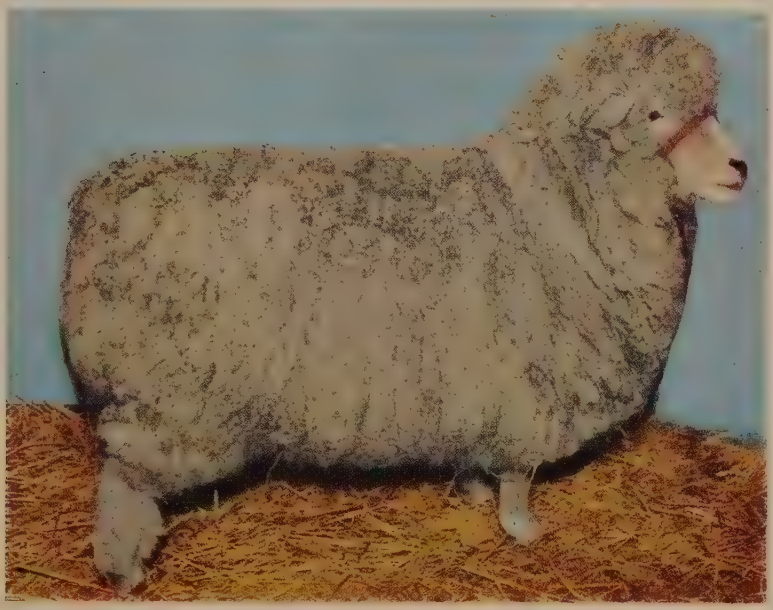

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5.—The Romney Marsh

by

J. A. MALLETT

THE Romney Marsh, sometimes known as the Kent, is the most popular of the British longwool sheep breeds used in Western Australia. Rams of this breed are widely used for mating with Merino ewes, the crossbred female progeny of the matings being in demand for subsequent mating with Downs-type rams to produce export lambs.

The breed takes its name from an expanse of about 50,000 acres of lowlying land in the county of Kent, England. For many centuries the sea has deposited vast quantities of silt along the coastline of south-eastern England, and the soils of the Romney Marsh range from rich alluvial loams to sand and shingle.

The town of Romney was one of the original Cinque Ports—Dover, Hastings, Hythe and Sandwich were the others—which, in the 13th Century, provided ships and men for the defence of the English Channel. Romney once boasted a famous harbour, but the course of the River Rother was changed by a great storm in 1287 A.D. and the gradual silting of the coast led to its decline.

Although the term "marsh" is something of a misnomer—reclamation work has continued there since the time of the Romans—the country is flat, treeless and lowlying. During World War II, about 150,000 sheep were moved from Romney Marsh to other areas in case it became necessary to flood the land as a defence measure.

Only hardy animals can thrive in this exposed area which is swept by gales from east and west and offers little or no shelter. Drainage channels or dykes suffice as fences and hedges in many sections of the marsh.

The breed has been kept practically pure for centuries as long before the introduction of a Flock Book, many Romney Marsh flocks were bred by families who handed them down from father to son and worked ceaselessly toward breed improvement.

It is highly probable that some Disnley Leicester blood was introduced late in the 18th Century—most British longwools benefited by such an infusion—but if this was the case it did not result in any diminution of the traditional hardiness of the Romney Marsh flocks.

The Romney Marsh sheep as we know it today has proved itself adaptable to a wide range of climatic conditions but remains unexcelled for wet country, having inherited a marked resistance to diseases such as footrot and fluke. Attention to such important matters as early maturity, better carcass conformation and improved fleeces has resulted in the development of a breed which has gained many friends throughout the world.

The Romney Marsh is popular in New Zealand, Australia and many South American countries where its foraging ability enables it to thrive under conditions where many other breeds could barely gain a living.

Although not quite the equal of the Border Leicester for early maturity, the

Romney Marsh is preferred in this State for lamb-breeding activities in the higher rainfall areas of the South-West and Lower Great Southern districts.

Romney Marsh ewes are good mothers, producing large quantities of milk and a high percentage of twin lambs under good flock husbandry conditions.

POINTS

Head—Wide; good thick foretop. Broad forehead, with no horns.

Face—Level between the ears, and white in colour; nose black. Face of ewes full; of rams broad and masculine.

Eyes—Large, bright, and lustrous.

Ears—Of good size.

Neck—Well set in at shoulders, strong and thick.

Shoulders—Wide, well put in and level with the back.

Chest—Wide and deep.

Back—Straight and broad.

Ribs—Well sprung; wide across hips.

Hindquarters — Rump well turned; thighs well let down and developed.

Legs and Feet—Legs short, displaying big bones, and white in colour. Large shapely feet, perfectly black and well woolled down.

Skin—Healthy pink colour.

Fleece—Of dense, even quality, spinning somewhere about 46's, and of a decided staple and character from fore-top to end of tail. Fleece should cover poll. The wool is of a demi-lustre type, five to six inches in length with seven to nine crimps to the inch, and the staples are more blocky at the top than is the case with other English longwools.

Corner Erosion can Cost You Money

Erosion down corners is the most common type of soil erosion. If the corner is not cultivated, the runoff will still be led to the same area and cause further erosion, or a boggy area will result.

Corner erosion can be eliminated by working the land on the contour in between simple guide lines. This method reduces the downhill run and reduces the length of each corner.

Australian

TRACTOR TESTS

DAVID BROWN 900D

REPORT ON TEST No. 31 (FARMERS' EDITION)

TESTED FOR DAVID BROWN (AUSTRALIA) PTY. LTD., LIDCOMBE, NEW SOUTH WALES

THIS Report is taken from the full Technical Report No. 31 of this test; test results are shown here in briefer form: fuller explanations are added. Values quoted may be rounded out to two instead of three significant figures; to this extent the values may differ slightly but not significantly from those shown in the Technical Report. Graphs of belt test performance, shown in the Technical Report, are not shown here. The Technical Report is not available in large numbers, but it may be seen at, and copies of this farmers' report may be had from, the offices of the State Departments of Agriculture, the Bureau of Sugar Experiment Stations (Queensland), and the Commonwealth Department of Primary Industry.

1. THE TESTS

(1) After twelve hours of running-in two types of tests were carried out, in order to measure *the performance of the engine,* as measured by the power in the belt driven by the belt pulley, and *the performance of the tractor as a whole,* as measured by drawbar pull, tractor speed, wheel slip, and drawbar horse-power (d.b.h.p.), with the tractor running on a bitumen test track.

The main results of these tests are given in Sections 2, 3, and 4. Other measurements and observations were made of various features of the tractor; these are given in Section 5.

(2) *Fuel Settings.*—The engine of this tractor has only one fuel setting, at which all the tests were carried out.

(3) *Governor Control.*—The engine was under the control of the governor set to give full throttle, and so maximum power at rated engine speed. (See note 2, paragraph 5, Other Observations, below).

(4) *Fuel.*—Distillate, Diesel Index 66, Specific Gravity 0.82; weight per Imperial gallon 8.17 lb.

(5) *Specification.*—Engine No. AD/30H 2411. For a brief specification of this tractor see Section 6 at the end of this report.

The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement, the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne.

2. SUMMARY OF POWER OUTPUT

Table A

——	At the Belt	At the Drawbar
Rated engine speed, r.p.m.	2,200	2,200
Corrected maximum power(*a*)	34·6	30·7
Rated power (*b*)	29½(*b*1)	23 (*b*2)

Note.—Letters in brackets refer to explanatory footnotes.

3. BELT TESTS

The belt tests show the power (belt horse-power, b.h.p.) that the tractor may be expected to deliver when driving a machine by the belt.

Table B.—Belt Test Results

	B.H.P.	Engine Speed	Fuel: Gall./hr. (*c*)	Fuel: lb./b.h.p. hr. (*d*)
1. Rated engine speed, 2,200 r.p.m.				
2. Fast idling speed, 2,390 r.p.m.*				
3. Observed maximum b.h.p. at rated speed	34·6	2,200	2·1	0·49
4. Corrected maximum b.h.p. rated speed (*a*)	34·6	No correction made for diesel engines		
5. Calculated rated load (*b*1)	29½			
6. Test at approximately rated load	30·0	2,265	1·9	0·52
7. Average loading under governor (*e*)	19·3	2,307	1·4	0·61
8. Equivalent engine torque at full throttle	82½ ft. lb. at maximum power and rated speed			
	97 ft. lb. (maximum) at 1,300/1,400 r.p.m.			
9. Repeat of (3) above after 80 hours	No change			

* See note 2, paragraph 5, Other Observations.

(*a*) Corrected maximum h.p. is calculated by a suitable formula from observed maximum h.p. corrected to 60° F. and 29.92" (sea level) barometric pressure. No correction is applied to diesel engines because there is no suitable formula; the values shown above are therefore the observed maximum powers.

(*b*) Engines are not expected to run indefinitely at full or maximum power output. But they can be expected to run continuously for some hours at *rated* output, which is less than maximum, defined as follows:—

(*b*1) Rated b.h.p. is defined as 85 per cent. of corrected maximum b.h.p.;

(*b*2) Rated d.b.h.p. is defined as 75 per cent. of corrected maximum d.b.h.p.

(*c*) Fuel consumption in gallons/hour may be a simple unit, but it has no meaning unless we also quote the corresponding h.p. output.

(*d*) This is the "specific fuel consumption," the weight of fuel consumed per unit of energy developed by the engine; the unit of energy here is the hp.-hour, similar to the electrical "unit," the kilowatt-hour. When this figure is least the engine is giving its best economy or efficiency. It is easy to change from column (*c*) to column (*d*) in Table B. e.g., as follows:—

2.1 gals./hr. while developing 34.6 h.p. means 2.1 ÷ 34.6 galls./b.h.p./hr. = 0.061 gall./b.h.p./hr.

0.061 gall./b.h.p./hr. x 8.17 lb./gallon for this fuel = 0.49 lb./b.h.p./hr., as shown in column (*d*).

(*e*) Line 7, Table B., represents the average performance one might expect from the engine while driving a variety of belt loads, from light to heavy. In terms of average fuel consumption, it means about 1¼ gallons an hour.

4. DRAWBAR TESTS

(1) The following Tables C, D, and E, show the drawbar performance of the tractor, on the bitumen test track, wearing rear tyres 13 x 28, carrying maximum weight (1,740 lb. front, 4,920 lb. rear; total 6,660 lb.), working in the gears named in the tables. Height of drawbar 15 inches.

Drawbar tests, using standard weight of tractor (4,500 lb.), were carried out, but are not reported here.

Table C.—Maximum Power Rated (2nd) Gear

	DBHP (*f*)	Pull lb.	Speed m.p.h.	Wheel Slip % (*g*)
1. Rated engine speed, 2,200 r.p.m.				
2. Observed maximum d.b.h.p. at rated engine speed	30·7	3,700	3·11	9
3. Corrected maximum d.b.h.p. at rated engine speed (*a*)	30·7	No correction made for diesel engines		
4. Calculated rated load (*b*2)	23			

Table D.—Pull at Maximum d.b.h.p.

All gears, rated engine speed. See note (*h*).

Gear	D.B.H.P.	Pull lb.	Speed m.p.h.	Wheel Slip %
1	20 (*i*)	4,450	1·7	15
2	30¾	3,700	3·1	9
3	31¼	2,800	4·2	6
4	30½	1,800	6·3	5
5	31¼	1,500	8·0	3
6	Road speed not tested			

(*f*) D.B.H.P. is the product of pull (lb.) and speed (m.p.h.) divided by 375.

(*g*) Wheel slip can be measured by noting that, in travelling a given distance, the back wheels make more turns when working under load than when running with no load on the drawbar. The difference in these

revolution counts divided by the former count gives the slip as a ratio, which can be written as a percentage (quoted in these tables to the nearest whole number).

(*h*) These are not the maximum pulls available in the gears (i.e., not the maximum sustained pulls), but the pulls at maximum d.b. power, i.e., at full-throttle at rated engine speed.

(*i*) Part throttle, maximum d.b.h.p. in first gear limited by wheel slip.

Table E.—Fuel Consumption, Various Loads, Rated (3rd) Gear

Pull lb.	Speed m.p.h.	DBHP	Percentage of Maximum d.b.h.p.	Slip %	Fuel	
					Gall./hr.	lb./d.b.h.p. hr.
1,650	3·47	15	49	4	1·3	0·67
2,150	3·36	19	62	5	1·5	0·62
2,650†	3·32	23†	75†	6	1·7	0·60
3,500	3·17	30	95	9	2·1	0·57

† Rated drawbar load.

(2) Interpretation of Drawbar Tests.

(i) Drawbar tests are carried out on a hard prepared surface. Most field conditions present higher resistance to the tractor's motion, so that, in the field, the maximum drawbar pulls available in any gear will usually be less than those shown in the tables.

(ii) Wheel slip may also be greater in the field; to that extent tractor speeds in miles per hour in the field will be less than those shown in the tables.

(iii) Because of (i) and (ii) above, the drawbar horsepowers available in any gear in the field will usually be less than those shown in the tables.

5. OTHER OBSERVATIONS

(1) *Duration of Test.*—80 hours, including running-in.

(2) *Repairs and Adjustments.*—(i) High idle speed had to be raised from recommended 2,330 r.p.m. to 2,390 r.p.m. to obtain maximum power at rated speed.

(ii) Belt pulley/p.t.o. unit twice replaced because of overheating of the ratio selector fork.

(iii) Injector in No. 2 cylinder dismantled, cleaned, and reset twice during tests.

(3) Engine—

Fuel settings—one, fuel pump sealed.

Heat controls—radiator with adjustable blind, thermostat.

Radiator water used—half-gallon.

Note.—On a day when air temperatures exceeded 100° F. (2.2.59) loads above about 80 per cent. full load could not be sustained because the radiator boiled.

Lubrication oil—Shell "Rotella" S.A.E. 30.

Weight to engine, 16.5 lb.;

Weight from engine after tests, 13.9 lb.

(4) Tractor Weights (lb.).

Weight condition	Front	Rear	Total
*Standard, unballasted .... (Pressed disc rear wheels)	1,460	3,040	4,500
†Maximum weight, heaviest recommended .... (Special cast centre rear wheels)	1,740	4,920	6,660
Includes—			
Water ballast (lb./wheel)	50	160	210
Solid ballast (lb./wheel)	90	300	390

* This weight, including driver and fuel, was used in finding centre of gravity.

Special Note on Light-Weight Tractors.—This tractor is of the light-weight type designed for the operation of implements that are mounted on the three-point linkage, and controlled through the hydraulic system in such a way that some or all of the weight of the attached implement can be carried by the tractor, while the implement is at work. In this instance this is achieved by the David Brown "Traction Control Unit".

A static test on the tractor in its standard, or light-weight condition showed that the hydraulic system was capable of increasing the tractor weight to not less than the maximum test weight (as in Tests F, G, and H) without lifting the front wheels off the ground and without overloading the rear tyres.

† Weight of tractor in drawbar tests quoted in this report.

(5) Wheels and Tyres.

Tyres	Front	Rear
Type	Rib	Open centre bar tread
Size	6·00 x 16, 4-ply	13 x 28, 6-ply
Pressure	28 psi.	15 psi.

(6) *Steering.*—With track widths, front 53″, rear 56″, wheel base 72″:—

Turning circles: Without brakes 22′ 10″ L.H., 22′ 10″ R.H.; with brakes 18′ L.H., 19′ 8″ R.H.

Comment: Easy to steer under load, sensitive to steering wheel; no power assistance.

(7) *Centre of Gravity,* with tractor in standard weight—12″ above, 23″ forward of rear axle.

(8) *Driver's Accommodation.*—Access to seat, from either side forward of rear wheels. *Foot-room and support,* flat foot plates, adequate. *Comfort,* metal plough type seat on rubber spring, adjustable fore and aft. *Accessibility to controls,* clutch and brake pedals 22″ apart, pedals approximately 14″ below loaded seat. Some controls are crowded.

(9) *Instruments.*—All clearly visible markings adequate. Indications were consistent throughout tests.

(10) *Inspection of Engine and Transmission after Test.*—After testing, the tractor was partly dismantled and inspected and found to be in a satisfactory condition, except that some signs of overheating were again noticed in the second replacement belt pulley/p.t.o. unit.

(11) *Instruction Books.*—Instructions for starting, running, and maintenance were satisfactory, and well illustrated.

G. H. VASEY, Officer in Charge Tractor Testing.
W. F. BAILLIE, Tractor Testing Officer.
16th March, 1959. University of Melbourne.

6. BRIEF SPECIFICATIONS

David Brown 900 D. (Based on Information Supplied by Manufacturers)

(1) Engine—No. AD4/30H 2411.

4-stroke; 4 cylinders, vertical; crankshaft along tractor; direct injection diesel.

Bore, 3⅝″; stroke, 4″; compression ratio, 15.9 : 1.

Rated speeds: Belt and drawbar work, 2,200 r.p.m.

Fuel type: Distillate.

Fuel system: C.A.V. rotary distributor pump, 4 hole spray type injectors. Two replaceable element filters in series. Tank capacity, 10 gallons.

Air Cleaner: Oil bath.

Governor: Mechanical, centrifugal incorporated in fuel pump.

Electrical system: 12-volt battery and generator.

Starting: Electric, cold start.

Cooling: Water (at atmospheric pressure) fan, pump, and thermostat, radiator blind adjustable from drivers seat.

Exhaust: Vertical, ahead of operator. D.B. standard muffler.

Lubrication: Oil pump and by-pass filter.

(2) Chassis—

4-wheel; pneumatic tyres.

Wheel base 72″.

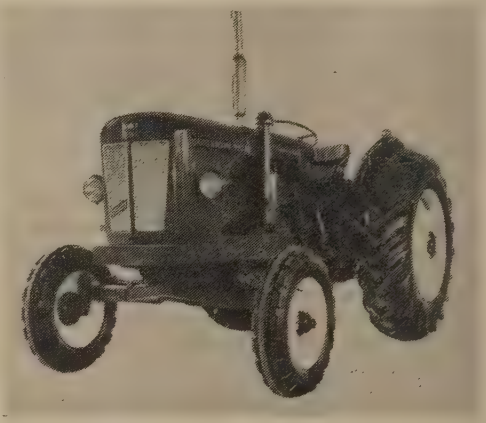
Track widths: Front 52″ x 4″ steps to 76″; rear 52″ x 4″ steps to 76″.

Tyre sizes: Front 6.00 x 16; rear 13 x 28.

Steering: Single worm drive.

Weight: Maximum, 6,660 lb.

(See "Other Observations," section 5).



(3) Belt Pulley—

Rear right side, clockwise rotation.

Diameter 8½″; face width 5¾″.

2 speeds (at rated engine speed), high, 2,070 r.p.m.; low, 1,375 r.p.m.

Belt speed (at rated engine speed), low 3,200 ft./min. in accordance with overseas standards (namely, 3,100 ± 100 f.p.m.).

(4) Power-Take-Off—

Centre rear; clockwise; guarded.

2 speeds: high, 1,050 r.p.m.; low, 660 r.p.m.; not in accordance with overseas' standards (namely, 536 ± 10 r.p.m.).

At engine speed of 1,800 r.p.m. p.t.o. would be 540 r.p.m. in low ratio.

Dimensions: 6 spline, 1⅜″ diameter.

Note: Belt pulley and p.t.o. comprise a single unit.

(5) Drawbar Swinging—

Seven positions across. Height as tested, 15″ (adjustable 13″, 15″, 18″).

Removal of swinging drawbar leaves fixed drawbar with 10 holes across.

Linkage mounted drawbar also available.

(6) Transmission—

Conventional gears.

Clutch: Single dry plate; 10″ diameter; pedal control and independent hand lever at left rear.

Gear ratios and road speeds (assuming no wheel slip) on 11.25 x 28 tyres, at rated engine speed, as advertised. (Tests were done on 13″ tyres. Speeds would be approximately 7 per cent. higher on this account).

—	Forward						Reverse	
Gear	1	2	3	4	5	6	H	L
Ratio	182·0	98·1	73·9	49·5	39·8	20·1	45·9	113·0
Speed, m.p.h.	1·7	3·1	4·2	6·2	7·7	15·2	6·7	2·7

(7) Hydraulics—

Built in, gear pump in transmission housing incorporates David Brown "traction control unit."

(8) Three-Point Leakage—

Generally conforms to BS1841-1951, Category 1.

Farm Tracks can be Dangerous

This type of damage occurs every year in the wheatbelt. Formed roads can be constructed by contract grader at less than £30 per mile. Where several farmers in a district need this type of work, they can bring a contractor into the district and guarantee an average two or three miles of road making per farm. You belong to a group, so why not try it!

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SEED STORAGE

IN

Relation to Germination

By G. R. W. MEADLY, Officer-in-Charge, Weeds and Seeds Branch

WE are often asked how long seed can be stored and remain suitable for sowing. There is no single answer as the period depends on a number of factors, including the type of seed, its condition at the time of storing and the nature of the storage.

Statements regarding the germination of wheat grains found in old Egyptian tombs are entertaining but have no foundation in fact. It is known with certainty, however, that some seeds having a thick coat impervious to water and air will remain viable for over 100 years. Seeds of a species of Cassia taken from Herbarium specimens, germinated after 158 years. Not quite so spectacular but nearer home, samples of subterranean clover seed stored in our own laboratory in 1935 are still producing seedlings 25 years later.

Under natural surroundings even longer periods have been recorded. Seeds of the Indian Lotus, a water plant, germinated quite readily after being taken from a peat bed in Manchuria. It was estimated that they had been buried for more than 200 years.

Most agricultural and vegetable seeds are not long-lived. In general, wheat does not decrease appreciably in germination for several years but under normal conditions of storage may lose its viability altogether in 10 years. Among the shorter-lived species are onions and parsnips. Both may show a reduction in germination within 12 months of harvesting.

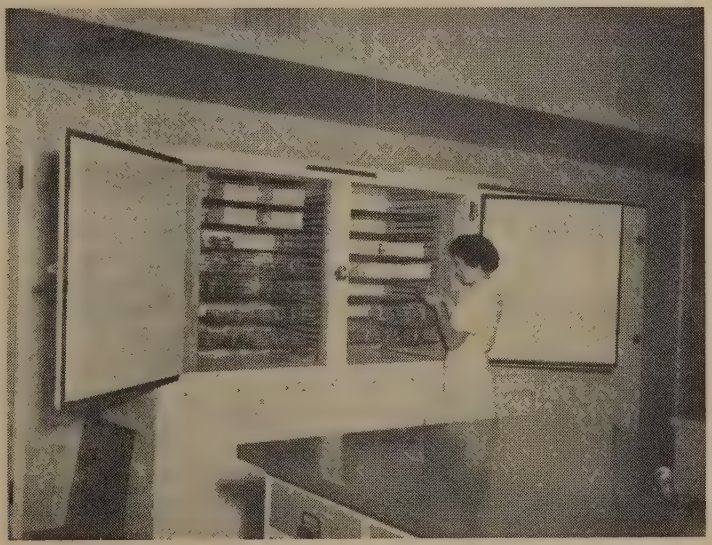

Fig. 1.—A thermostatically-controlled incubator at the Department of Agriculture seed testing laboratory. This is used for germination tests

STORAGE IMPROVES SOME SEEDS

In some cases the germination may increase rather than decrease during the first year or so of storage. Quite a number of seeds require a maturing period and give no real indication of their ultimate value if tested immediately after harvesting. Typical examples among species produced in this State are perennial veldt grass and buffel grass while Rhodes grass and Paspalum have similar characteristics. After being stored for a few months, seed which initially gave little germination can behave in a normal fashion.

As already mentioned, the conditions of storage play a very important part in deciding how long seed will remain viable. There is nothing subtle about the damage caused by mice, or for that matter, insects including the various grain weevils. Less obvious but no less decisive are the moisture content of the seed along with the humidity and temperature of storage.

Fig. 2.—Onion, lettuce and carrot seed sealed in cans after the moisture content has been reduced

MOISTURE AND TEMPERATURE

Well-matured seeds carefully harvested in dry weather have the greatest potential for maintaining viability. The moisture content of the seed, particularly in countries where rain may occur when the crop is mature, is most important and often it is necessary to reduce this by natural or artificial drying. Various workers have established "critical moisture contents" for seeds above which, under normal storage conditions, they lose viability rapidly and below which it is maintained for a reasonable period.

The position is complicated, however, by the fact that the influence of moisture and temperature are inter-related. A moisture content and relative humidity quite safe at a low temperature can result in rapid deterioration as the temperature increases.

You could reasonably comment that this all sounds rather academic but what are the practical implications. Trouble with seed storage occurs mainly in tropical and sub-tropical countries, but some lines which pass through the tropics on their way to temperate countries may also be affected. Knowing the basic causes of rapid loss in germination it has been possible to overcome the problem in part. Besides the drying already mentioned, some of the more valuable and temperamental seeds, such as vegetables, are stored at low temperatures, approaching freezing point, along with a relatively low humidity.

CANNED SEED

In many cases, where the temperatures cannot be controlled, it is possible to dry the seeds and maintain them at a low moisture content. A fairly recent development in the United States has been the packing of seeds in moisture-proof or resistant containers following drying. While at Modesto, in California a few months ago, I had the opportunity of watching lines being canned in much the same way as jam or fruit, and laminated foil packages are also used quite extensively.

This scientific advance has now been introduced to Australia, a Sydney firm having announced that it is in a position to offer dry-conditioned seed packed in moisture-proof containers. As newly harvested seed comes to hand, it is proposed to make a full range of vegetable and flower varieties available to commercial growers. This will be of particular advantage to growers in northern New South Wales and Queensland.

(From an A.B.C. Country Hour broadcast.)

Hit Rabbits This Winter

It Will Check Breeding and Give More Valuable Feed for Summer Grazing

By C. MARSHALL, Field Superintendent,
Agriculture Protection Board

NOW that the current summer "1080" Rabbit Drive is drawing to a close, it is time we considered our future plans. I am afraid that in the past most farmers have relied far too much on summer control as the complete answer to rabbit destruction and that this reliance has increased considerably following the introduction of "1080" poison, plus the valuable assistance received from the myxomatosis virus.

This dependence on annual drives is a legacy from the days when phosphorus poison was considered to be the answer to the rabbit problem, and I believe most of us still remember the disappointing kills obtained from this bait. Observations during the past two seasons indicate that we may be heading in the same direction again. Rabbits are definitely increasing and the annual summer drive has failed to hold the population down to a safe level, with the result that we have a slightly larger population to carry throughout the winter, which in turn means increased breeding. This trend has become most noticeable during the past two seasons.

I do not claim that rabbits have reached the numbers prior to myxomatosis and "1080," but they are on their way back and that now is the time for all conscientious farmers to make the effort to stop them.

Following the introduction of "1080" poison, the Agriculture Protection Board tried to interest landholders in winter and spring control. We received limited support for this idea and the work undertaken gave very encouraging results, with considerable numbers of breeding does destroyed. However, weather conditions during winter make the organisation of unit work difficult and continuous interruptions from rain discouraged most farmers. We also had to overcome the lack of interest that followed the reduction in rabbit numbers.

Today, we have still another problem to face—the commercial value of rabbits. Past history of rabbit control should convince farmers that neither trapping or summer drives in themselves will solve our present problem.

What can we do to overcome the steady build-up in rabbit numbers? I believe that we will find the answer in winter work. Summer control is fairly easy. Rabbits will quickly make their presence known by concentrating on the choicest areas of feed, and signs will be clear and numerous. Therefore, if trails are placed correctly and fed wisely, we must obtain a fairly high percentage kill.

With winter work, the degree of skill required is far greater. Rabbits are scattered and leave few signs; feed is usually plentiful and rabbits have no reason to travel far from their shelter. To successfully destroy them we must first locate all pockets of infestation and then plan our programme accordingly. Every pocket, no matter how small, should receive treatment. Remember, one doe rabbit destroyed in winter can mean at least 20 less to feed through the spring and summer.

WINTER CONTROL

If using poison bait, cut trails close to and around all cover and warrens; feed according to recommended methods and keep on feeding until you are reasonably sure that most rabbits in the vicinity are visiting your trail. I would suggest that

you feed from six to seven days before baiting. The time spent on this work will be well repaid by the results obtained. If your work is interrupted by rain, do not abandon the trail but keep feeding. This can be reduced to every second or third day until the weather settles. Some farmers have been known to feed for up to three weeks under similar circumstances. You will find that rabbits will not desert the trail and you will also notice that they will welcome a feed of grain during wet, cold weather. When you consider conditions are safe, poison the trail.

One of the most important points to remember in rabbit control is that you cannot afford to forget this pest for long periods. A number of farmers do a reasonably good job and promptly forget the rabbits until the following year. Some do a not-so-good job and blame their neighbours or adjoining bush for the rabbits they fail to kill. Some trap, and drive a large percentage of rabbits away on to the adjoining properties, then claim good results. The man who really gets results is the farmer who keeps re-checking his work and, if not satisfied, repeats the job, keeping at the rabbits until he has beaten them.

ANNUAL CONTROL

The ideal programme for each year should be planned along the following lines. Poison the entire infested areas early in the summer, say, during January; repeat the work again in May if necessary; rip all warrens and destroy cover during the summer and autumn months. Regularly check known infested spots through out the year; fumigate any warrens that have opened and re-rip if practical. Spot poison all pockets of rabbits noted and repeat every six weeks throughout the winter and spring if you consider this is justified. Remember, a few rabbits soon become many, if neglected.

Do not rely on the Agriculture Protection Board's "1080" Units for complete control. Do as much of your own work as possible, in fact, do it all, if you can, and above all don't place your faith in trapping. Use traps by all means if you wish, but include this type of work as part of your over-all effort and not as a control in itself. Do not try to poison rabbits following trapping—let at least three weeks elapse before making the attempt.

The Agriculture Protection Board has been accused of encouraging a policy favouring summer drives to the exclusion of other work. This is not correct.

We have been forced into this position because this is the only period of the year when it is possible to get the majority of farmers to co-operate and a drive of this nature is the best method at our disposal for the mass destruction of rabbits, but in addition to summer work we have always strongly advocated the continuation of control throughout the year by encouraging farmers to spot poison pockets of rabbits, fumigate and rip warrens, destroy cover and generally harass the rabbit at all times. Our advice to farmers is to destroy rabbits when you see them. There has also been considerable comment on rabbit migrating from virgin bush country to re-infest cleared holdings.

We acknowledge that rabbits do exist in most of our uncleared lands, also on the coastal strips. However, the numbers are only a fraction of those living on developed country. We also admit that these rabbits are a nuisance, but do do not agree that they are the major cause of our present problem. The Agriculture Protection Board, in co-operation with local Road Boards, Forestry, Railways, and other interested authorities, has steadily increased the work of control over undeveloped areas during the past three years, and we hope that, given time, this problem will be overcome.

Our vast undeveloped areas make the possibility of eradicating rabbits very remote. The best we can hope to achieve is partial control, and to obtain this everyone must work continuously on the problem. Without this continuous work we will not maintain the progress made during the past six years. Unfortunately, rabbit control is a never-ending job, requiring our continuous attention. Results from our work are not always obvious and returns may be slow. Nevertheless, the benefit is there, as many farmers have proven from increased production over the past years.

DECOMMERCIALISATION

There has been lively interest shown in the suggested decommercialisation of rabbits, with references to the value of rabbit carcasses on the export market. Suggestions have been made that trapping should be encouraged.

Commercial trappers had a free hand for many years, and the net result from their efforts was more rabbits. However, let us put aside the question of what we consider to be the best method for destroying this pest and have a look at the cash angle as it affects the farmers. At present inflated prices, rabbits are returning up to 5s. per pair. It is considered that eight rabbits will displace one sheep. Some authorities give this figure as six rabbits. However, let us take eight rabbits for our figure. Four pairs of rabbits at 5s. means a return of £1. Now, compare this with the average value of a breeding ewe and her progeny. The State average wool clip, per head, is 9 lb., with an average price of 4s. 6d. per pound. Add to this a lambing percentage of 75 per cent. for the flock and value the lamb at a low figure of 30s. To this we add the value of the ewe herself at £3 per head, and this gives us a total return of £6 10s. 6d. as against £1 for the rabbit. I doubt if anyone could justify the farming of rabbits on these figures. There is still another point we must not overlook and I refer to the farmers themselves, who, as a rule, do not receive any benefit from commercial trapping. This means that to them rabbits are a dead loss.

I believe that most thinking people now realise that there is no easy way for controlling rabbits, and until such time as we all decide to intensify our efforts in all fields of control, rabbits will continue to be a problem.

I take this opportunity to remind all farmers of the following well known and most important points that must be considered when planning control work. Rabbits are timid and suspicious. They take fright easily and every care should be taken not to disturb them before commencing control work.

Make sure that you have a full knowledge of all infested areas requiring treatment. Study their feeding habits and place your trails to the best advantage. Be sure to cover all areas. Your trail should be wide and shallow. Use only the best baiting materials; make sure this is clean and free from contamination. The same applies to all utensils used in mixing and storing the bait.

Free feed generously, but do not over feed. Increase or decrease the amount of feed daily according to the condition of the trail. Don't try any short cuts; it doesn't pay.

Success is not possible all the time. Factors unknown to you may be responsible for occasional failures. If not satisfied with results repeat the work at a later date. Sufficient baits should be laid to ensure that all rabbits visiting the trail are provided for. If no bait remains after the first night, lightly re-poison the trail. Leave the bait down for at least three to four days before covering.

Do not put stock back on the area treated before examining trails to see that all bait has been taken or covered.

Destroy all cover harbouring rabbits. Fumigate warrens in rocks, creek banks, bush, etc. Rip those in open paddocks.

Follow up ripping by fumigating any holes re-opened. It is always advisable to poison before ripping.

If apples are available they should be used in preference to oats during the dry season. Oats should be used for winter and spring baiting. A few apples mixed with the oats will help to destroy foxes. Never bait where stock is grazing. In summer, keep your trails well out from cover and warrens. In winter, work close to cover and warrens; this helps to get the kittens.

Never trap where you intend to poison. Don't confine your work to any particular season of the year. Keep at the rabbits until they are exterminated.

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PLANT DISEASES

BACTERIAL WILT OF POTATOES

BY THE PLANT PATHOLOGY BRANCH

EACH season, Bacterial Wilt causes heavy losses to individual growers in several of the potato districts throughout the South-West of the State. The disease is incited by the bacterium *Pseudomonas solanacearum* E.F.Sm. and is most prevalent in the districts of Donnybrook, Pemberton and Manjimup as well as in the area between Waroona and Dardanup. It is a tuber-borne disease which is extremely difficult to eradicate, once it has been introduced on to a property.

Usually the disease becomes evident in a crop during the warm weather when single stalks on whole plants show signs of wilting (Fig. 1). In the earliest stages, only the terminal leaflets may be affected, but as the organism multiplies within the sap-conducting tissue, this symptom becomes more general. Yellowing of leaves sometimes precedes wilting, but it may not occur when the onset of the disease is sudden.

The sap-conducting tissues of the stems, stolons, roots and tubers (Fig. 2) turn brown, and frequently a whitish bacterial slime exudes from these organs when cut.

A symptom of the disease in tubers is often referred to as "sore-eye" (Fig. 3). It is characterised by the blackening of eye tissue and the exudation of bacterial slime. Soil particles commonly adhere to this slime on the eyes of freshly dug potatoes.

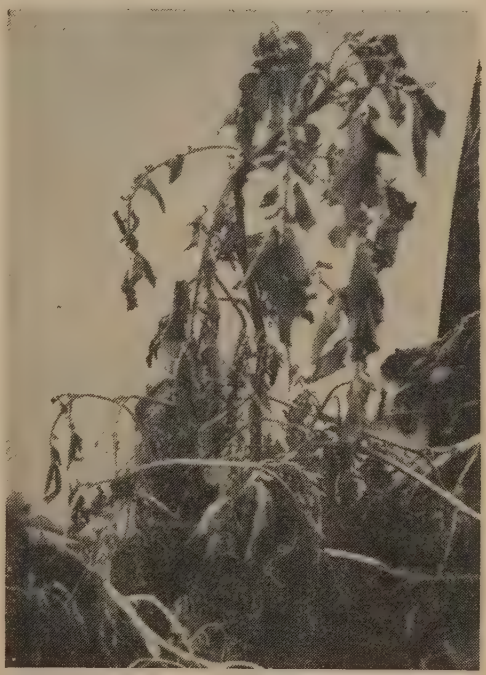


Fig. 1.—Field symptoms of bacterial wilt. This plant has wilted under conditions of adequate soil moisture

INTRODUCTION AND CARRY-OVER

The disease is introduced mainly by infected seed-potato tubers and its initial spread occurs in the process of cutting these tubers. Occasionally the introduction occurs through infected tomato trans-

plants. The subsequent development of the organisms is favoured by warm moist conditions.

Following the collapse and decay of affected plants, the bacteria pass into the soil where they may persist for several years and act as sources of infection for future crops.

The disease may also be perpetuated by alternate hosts as the organism has been recorded on many different species throughout the world. However, in Western Australia, tomato and tobacco are the only other species that have been recorded as hosts of Bacterial Wilt.

PREVENTION AND CONTROL

1. Use only clean seed-potato tubers. Do not plant tubers from an affected crop.

2. Use sterile knives when cutting tubers. Boiling water, 2 per cent. Formalin or 1 per cent. Cetrimide may be used for sterilisation. Diseased tubers found when cutting setts, should be destroyed by boiling.

3. Adopt a rotation of at least five years on contaminated land.

4. Where necessary, improve the drainage of land that has borne a diseased crop.

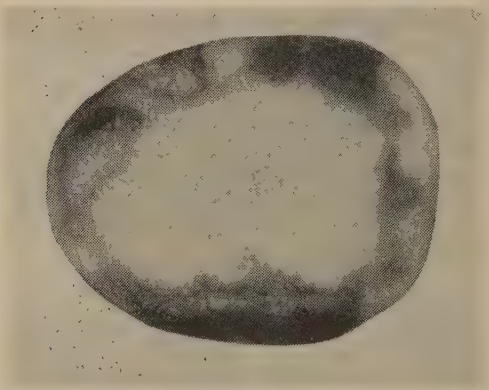


Fig. 2.—Section of tuber affected with bacterial wilt. The discoloured ring of tissue contains a bacterial slime which will ooze out if the cut tuber is squeezed gently

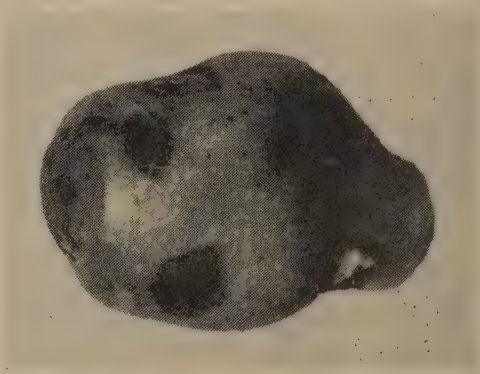


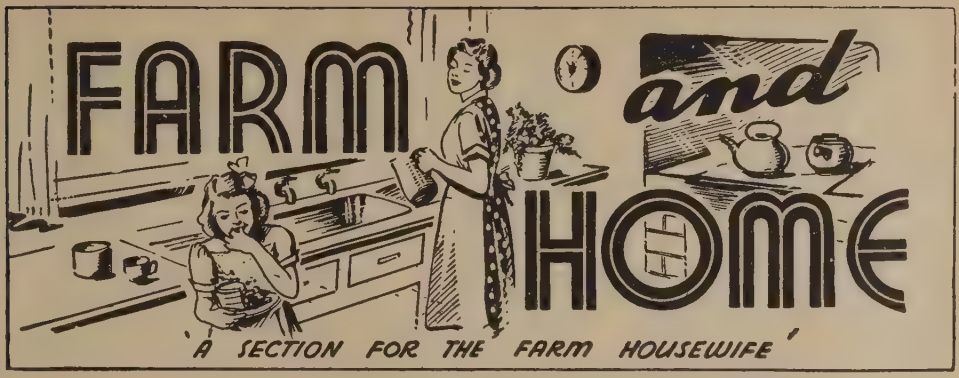
Fig. 3.—"Sore-eye" condition of tuber, caused by bacterial wilt. Note blackening of eye tissue

KEEP YOUR JOURNALS

HERE at the production end, we are sparing neither expense nor effort in making the "Journal of Agriculture" a publication which will help you in your farming operations.

We suggest that the Journal is worth keeping and that a year's issue will make an attractive and useful volume for your library—a volume that is full of sound factual information, attractively presented.

Arrangements have been made for the compilation of a comprehensive index to be incorporated in the December issue—a feature which will greatly enhance the value of the Journal as a work of reference.



The Laundering of Table Linen

By HELEN M. GLOSTER

THE eye-appeal of a dinner-table is always enhanced by good quality napery—and to my mind there is nothing to equal the appearance of a well-laundered white linen damask tablecloth with table-napkins to match.

The best quality damask is made from pure linen and requires very little starching, as linen is naturally stiffer than most other textile fibres.

Cheaper cotton damasks, or even linen which has worn thin with age and usage, will require thicker starch to improve their appearance and to prevent rapid soiling.

The proportions for starching are given here on the assumption that the articles are of good quality material and dry. In actual practice articles go straight from the last rinsing water into the starch. Material takes up the starch more readily when wet so allowance must be made for the water in the articles themselves when thinning down. Omit some of the "thinning down water" if you are starching cotton breakfast cloths, thin cloths and items of this nature.

STARCH

Rice starch gives by far the best results. The starch cells in a rice grain are very small, even and compact, whereas the cells in starch from wheat or maize are much larger and uneven in size. Rice starch is not always readily available on the market, but it is quite a simple matter to prepare your own starch.

Plan to have a plain boiled rice pudding or curry and rice on the day before washing day. Cook the rice in plenty of water and strain off water as soon as rice is cooked. Save this rice water and use for starching on washing day.

Standard Boiling Water Starch.

Ingredients—

2 tablespoons of starch.

1 cup cold water (for blending).

1 teaspoon borax (gives added stiffness and gloss to linen) few shreds of whitewax or candle wax (gives gloss and makes iron run smoothly).

Boiling water.

1 cup of cold water.

Method—

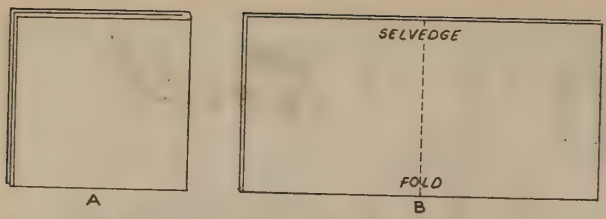
Blend the starch until free from lumps using 1 cup of cold water.

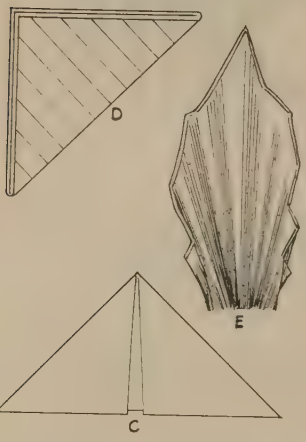
Add borax and whitewax.

Add boiling water, stirring all the time, until starch turns thick and clear.

Stir in 1 cup of cold water. This prevents a skin forming on top of the starch.

Cover starch until required.





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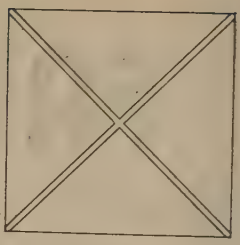
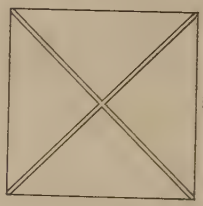
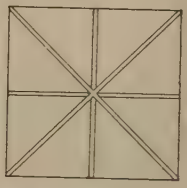
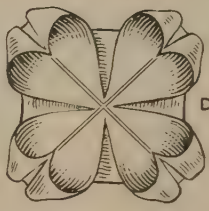
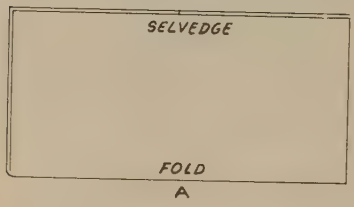
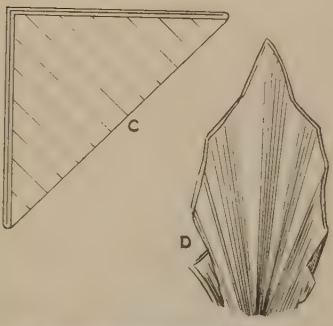




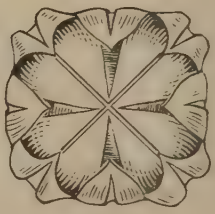


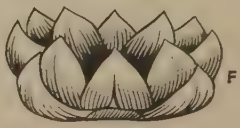






The RAPID





The WATER LILY

Fold selvedges to centre crease to make a triangle (c).

Turn the triangle over.

Fold the right hand corner to left hand corner making another triangle (d).

Fold from the lower corner into even pleats concertina fashion (e).

Lift up (f).

Place sideways and pull the corners downwards, right and left in the shape of petals and place in a glass.

THE "WATERFALL" OR "RAPID"

This is similar to the "Orchid" and both are suitable for long tables for wedding breakfasts, big dinners or other functions.

Method

Place table napkin on the table right side up.

Fold in half, selvedge to selvedge (a).

Place hem to hem to form a square (b).

Put the folded corner over to the opposite corners to form a triangle (c).

Form into pleats, concertina fashion (c) and (d) see that the double fold of the table napkin comes at the back.

Place napkin in a glass and pull down the single corners each corner overlapping the one below.

THE WATER LILY

This looks particularly attractive on a dinner table with a bread roll or cube of bread placed in it.

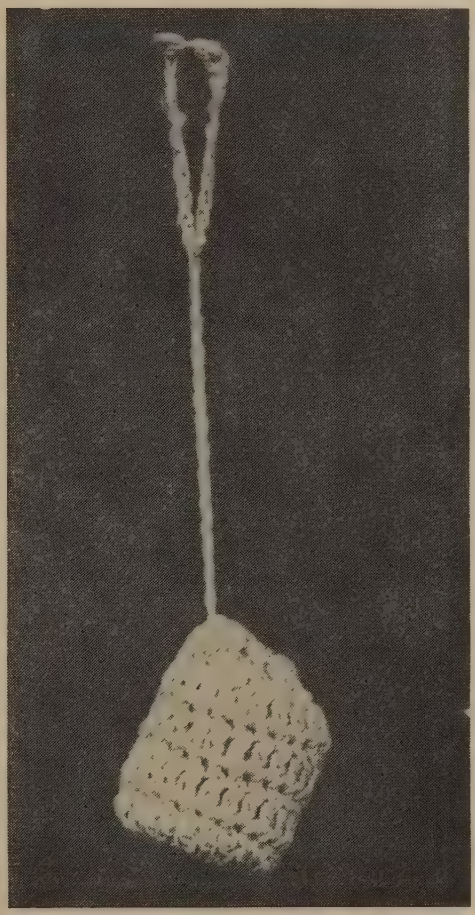
For some occasions a small spray of flowers or a small gift may be placed inside.

Method.

1. Make sure the table napkins are square.
2. Place table napkin right side up on the table.
3. Fold to find the centre.
4. Unfold then fold four corners to the centre (a).
5. Repeat (4) twice.
6. Turn the table napkin over and fold corners to the centre once more.
7. Place fingers of the left hand firmly on the four folds in the centre.
8. With the right hand pull up each of the under petals, the last four being drawn upwards firmly, to make the lily a good shape.

A Bag for Blue

HAVE you ever bought a knob of blue and found it was in a paper wrapper? Try making this blue bag. It may be refilled over and over again and may be hung up to dry after use. The bag illustrated was made of cotton netting twine although any coarse strong crochet cotton will do. A No. 11 crochet hook was used.



Method.

First round.—Make 6 chain and close the ring with a single crochet.

This starch is thick and needs thinning down before use.

Thinning Chart.	Starch. Cup.	Water. Cups.
Best quality linen tablecloth	1	8
Medium quality	1	6
Cotton breakfast cloth	1	4
Good table napkin (linen)	1	6
Cotton table napkin	1	4

This chart is a rough guide only as materials and individual tastes vary considerably.

In actual practice, if articles are starched while wet in order of stiffness required, each succeeding article automatically thins down the starch to the required strength.

If starch becomes too thin a little "standard starch" added from time to time restores it to the necessary strength required.

TO IRON A TABLECLOTH OR BREAKFAST CLOTH

It is important that old starch is removed before material is restarched. This is done by thorough washing and rinsing or boiling and rinsing.

Dry the cloth in the sun after it has been starched then damp down thoroughly, roll up firmly and leave for at least half an hour, preferably longer, until moisture is distributed evenly.

Folding.

You will need a "helper" to assist in folding the cloth and pulling it into shape.

Each person takes a hem, shakes and pulls cloth, then folds selvedge against selvedge, with the right side inside pulling the selvedges until quite straight. Cloth is folded again in the same direction then pulled until hems are straight.

Screen fold by dropping the outer single fold and picking it up on the other side. This makes a screen fold of four, or an M fold with the right side to the outside.

Pull again, then place into position for ironing.

To Iron.

Place the cloth with the folds towards you. Iron the hem first, as this sets them and keeps them straight.

Iron the top fold, being careful to keep both fold and selvedge straight.

Fold the top layers over away from you and iron on top of the fold nearest to you.

Replace the first fold so that folds are once more towards you.

Turn the cloth over from end to end and iron the two remaining folds in the same way as the other two.

To iron folds on the wrong side, place the cloth with selvedges towards you then fold layers as you did when ironing on the right side.

Ironing on the wrong side is important for damask as it makes the pattern show up to advantage on the right side. Touch up any creases or damp spots with the iron. Air thoroughly before rolling tying and putting away.

TABLE NAPKINS

Prepare for ironing by starching, drying, then damping down.

Pull table napkin into shape, seeing that hems and selvedges are straight and corners rectangular and even.

Place about half table napkin on table, right side uppermost, smooth surface with the hands.

Set the hems with the iron, then the selvedge.

Iron remaining portion in the centre, half at a time. Moving ironed part away iron remainder of table napkin until dry. Turn over and iron quickly on the wrong side.

Fold in a screen fold of three or N fold. Take the outer corner where the wrong side is uppermost and fold back corner to corner so that right side is uppermost.

Air well.

FANCY FOLDS FOR FESTIVE OCCASIONS

There are a great variety of fancy folds for table napkins and many of these are very easy to make. The table napkins should be perfectly square; the large 24 in. size is best and they need to be starched, somewhat stiffer than those normally used. Some designs, the "Orchid" for instance, work out quite well with paper table napkins which are much smaller.

THE "ORCHID"

Method.

Place table napkin on the table right side up.

Fold in half, selvedge to selvedge.

Fold hem to hem to form a square, press in creases (a).

Re-open once (b).

Second round.—Make 2 chain to form an upright stitch, then 11 treble into the ring. Close the circle with a single crochet.

Third round.—Make 2 chain, then one treble into the space at the base of the chain. Make 2 treble into each of the remaining spaces between stitches in the previous round. There should now be 24 upright stitches.

Fourth, fifth, sixth and seventh rounds.—Make two chain to form an upright then one treble into each space between stitches of previous round. Close each round with a single crochet. There should be 24 uprights in each of these rounds.

Make 36 chain and end off.

Thread chain through top of bag to make a draw string. Insert a knob of blue before drawing up the string. Make a loop for hanging at the end of the string.

TO CHOP PARSLEY

1. Wash parsley and dry thoroughly.
2. Gather parsley into a tight bunch in the fingers of the left hand.
3. With a sharp knife slice through the parsley thinly.
4. Hold one end of the knife down and with the other hand chop rapidly.

TO CURL CELERY; RADISH

Take short lengths of celery or radishes wash and clean well.

With a sharp knife, slit a number of times along the length to within half an inch of the end (narrow end for celery, broad end or top for radish). Leave to soak in very cold water, until celery or radish curls. These make attractive decorations for salads.

Gully Stops are Successful — Sometimes!

This photograph shows two gully heads and two stone gully stops put in at the same time at the head of each gully. One has been successful so far, the other was not successful.

Don't tackle the problem so far downhill, get up the hill to the area losing the water. You can increase your yields while you cure the erosion.

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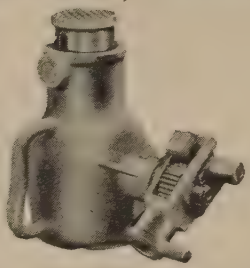

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Hormone Sprays for APRICOTS

By J. CRIPPS, B.Sc. (Hort.), Research Officer

VARIOUS hormone sprays have been applied to apricots with the object of increasing fruit size and hastening maturity, and of these 245TA, the tri-ethanol amine salt of 245 trichlorophenoxyacetic acid, has in general, proved the most successful. The increase in fruit diameter obtained with this spray in Western Australia has varied between 5 and 15 per cent. and is due to an increase in the size of the cells within the fruit, not to the production of a greater number of cells.

Larger fruit is of course of advantage to the grower, but it is felt that advanced maturity is of greater economic advantage in the case of the Newcastle variety, for it has been observed that prices for fruit fall rapidly early in the season. Therefore, if the crop can be marketed a few days earlier, a higher return will result and fruit sprayed with 245TA matures five to seven days earlier than unsprayed fruit.

The observant reader will discern a further advantage here, in that the harvesting of a crop of apricots can be spread over a longer period if only half the trees in a planting of one variety are sprayed.

Lastly hormone spraying reduces pre-harvest drop and increases fruit colour, while flavour remains unaffected.

METHOD OF APPLICATION

The concentration of hormone employed is largely determined by the tendency of fruit sprayed with high concentrations to split. This tendency to split varies according to variety and with growing conditions.

For instance, fruit of young vigorously-growing trees receiving heavy irrigation is more liable to split than fruit of old trees grown under adverse conditions.

In the case of the variety Newcastle, a concentration of ten parts per million has been found to be safe provided that the trees are not watered during the three weeks before harvest. Watering before harvest can incidentally result in splitting even in the absence of hormone application. The varieties Moorpark, Tilton Trevatt and Royal can be sprayed at 12½ p.p.m. but Blenheim and Oullins should not under any circumstances be sprayed with 245TA.

The correct timing of the spray application is important since late application reduces the benefit obtained and the spray should be applied at the commencement of pit hardening.

This stage in the development of the fruit can be detected by cutting a few fruit with a sharp knife when it will be found that, although the pit is still soft, its pointed end at the base of the fruit fails to allow the passage of the knife. This stage is reached approximately four weeks after full blossom with the variety Newcastle, and five to six weeks with mid season and late varieties.

A spreader must be included with the spray to give reliable results and a detergent type should be utilised. Also thorough spraying is essential, and two to four gallons of spray per tree should be applied.

Recommendations for the use of 245TA on apricots may therefore be summarised as follows:—

(1) Apply the hormone at 10 parts per million to the Newcastle variety and 12½ parts per million to other varieties.

(2) Do not spray Blenheim or Oullins with 245TA.

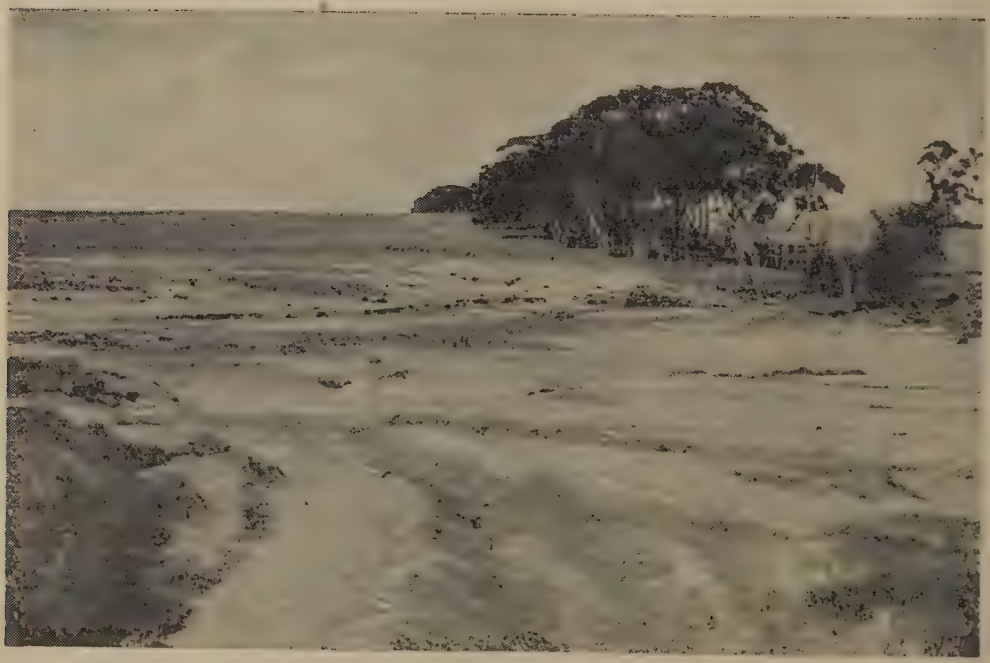
(3) Apply the spray one month after pit hardening.
Include a spreader and spray thoroughly.

After spraying, the grower will probably observe a certain amount of foliage wilting coupled with a stoppage of the new growth, but these effects are only temporary and need not cause alarm.

In conclusion it is essential that fruit growers realise that hormone spraying cannot be employed as a substitute for thinning as it is less effective when applied to trees carrying a very heavy crop. Thinning should therefore be carried out before spray application either by hand or by the spray thinning method described in a previous article published in "The Journal of Agriculture of Western Australia" Vol 8 (Third Series), No. 3 (May-June, 1959), Page 361. This article "Spray Thinning of Newcastle Apricots" was reprinted as Bulletin 2642.

Growers wishing to employ hormone sprays would be well advised to contact their local Horticultural Adviser or Instructor for more detailed advice.

Salty Seepage is An Erosion Hazard



The above photograph shows a salty seepage occurring on a hillside in the York district. Such areas become bare and act as focal points for water erosion. They can often be reclaimed by adopting appropriate soil conservation measures and encouraging the growth of salt-tolerant plants, shrubs or trees suitable for these conditions. The Soil Conservation Service can advise concerning the details of this reclamation.

The Fruit Industry IN OTHER LANDS

1—THE UNITED KINGDOM

By F. MELVILLE, Fruit Adviser, Western Australian Department of Agriculture

THE following report deals with the many aspects of fruit growing both technical and commercial covered during a tour of three overseas countries undertaken on behalf of the Department of Agriculture and the fruitgrowers of Western Australia. In the course of the three and a half months spent on this work, 13 research establishments were visited and contacts were made with research personnel both within these organisations and elsewhere. Visits to commercial fruit growing areas were made with extension officers and these included brief visits to packing houses. Altogether I had discussions with 127 research and extension personnel and industry representatives.

It was not possible in the time available to cover all aspects of fruit-growing nor the vast field of horticultural research. It was necessary to confine my attention to matters directly related to fruit-growing problems at home and, in many instances, visits had to be limited to discussions with research workers as time and distance did not permit inspection of trials in the field.

In reading this report it should be borne in mind that the observations are made in relation to the limited areas visited and on this account may carry a certain amount of bias.

The subject matter is dealt with under the three countries concerned and the American section is further subdivided into kinds of fruit. The detail is dealt with under subject headings covering the various aspects of fruit culture.

FRUIT-GROWING IN BRITAIN

THREE weeks were spent visiting research institutions and commercial fruit areas in the United Kingdom. Places visited included the East Malling Research Station, the Long Ashton Research Station, the National Agricultural Advisory Service (N.A.A.S.) Experiment Station, Luddington, the National Institute of Agricultural Engineering at Silsoe, Bedfordshire and commercial orchards in Gloucestershire, Worcestershire and Kent.

COMMERCIAL GROWING

The largest property visited, the "Man of Ross" orchards at Ross on Wye, covers 700 acres including cider apples and is equipped with a large packing shed and cool stores. Other orchards varied in size from 500 acres down to 30 acres. Among the dessert apple varieties being grown were Cox's Orange Pippin, Worcester, Bramley, Crimson Cox (red sport of Cox) Laxton Superb, Fortune, Tydemans Late, Grenadier and Beauty of Bath. Pears included Conference, Comice and Williams (Bartlett). Most orchards are laid down to permanent sod which is mown continuously during the year. Several systems

of pruning have been developed experimentally but the commercial grower is mainly using the Delayed Open Centre system with a trend towards the pendulous habit of the Regulated systems. Pruning is generally light and together with picking and packing is often carried out by women. The fruit is picked into lugboxes and at present there is no development of bulk handling in the orchard. Growers are very conscious of the need to prevent bruising, and mechanical sizing and handling in the packing shed are reduced to a minimum on this account.

Fig. 1—A vigorous two-year-old apple tree in a young English orchard

Many growers have their own cool stores and market direct to the large centres. Apples are normally cool-stored loose and removed as required for marketing. Gas storage is common, particularly for Cox which must be stored at around 38° to prevent low temperature injury. Cox ex gas store were being marketed in very good condition in March. Gleosporium rot is a serious storage disorder with Cox and no satisfactory control has been found. Wastage in some lines runs as high as 25 per cent.

A large proportion of the fruit is marketed in returnable wooden boxes. These are either packed (for top grades) or loose filled (inferior grades) and covered with a sheet of paper stapled on the top carrying the grower's brand or name. Wrapping of fancy grade fruit is becoming more common to compete with imported fruit and some growers are using cardboard cartons. Boxes contain, 20, 30 or 40 lb. of apples.

The fruit is not marketed in accordance with specific grading regulations hence there is a wide variation in quality and presentation. One of the problems hampering the introduction of grading regulations is the large areas of farm orchards where apples are being grown under very poor conditions with practically no attempt at disease or pest control, or proper grading or packing. The apples, mostly Bramley, are often shed-stored during the winter and bring very low prices. The Government is encouraging the removal of these orchards which are not economical and are adversely affecting the fruit industry.

APPLE ROOTSTOCKS

Apple rootstock trials have been in progress in various centres for many years and a considerable amount of information is available on performance. Of the original Malling series, selected from existing clonal material in the early 1920's, MII is the stock which has emerged as the principal commercial choice and is expected to remain popular for some years yet. It is the basis of comparison in all recent experiments. MIX the most dwarfing stock available is still frequently seen in commercial orchards mainly as fillers but new plantings on this stock are limited. MVII and MIV are also restricted as far as new plantings are concerned. A number of trials also include the more recent Malling Merton series—crosses mainly between Northern Spy and MII and MIV —which are woolly aphid resistant. Of these MM 104 has consistently proved superior in cropping to all other stocks. It forms a moderate-sized tree, is quite well anchored and seems certain to become the most popular commercial stock of the future in England. In a trial at East Malling the production of Cox up to the age of 14 years has been 50 per cent.

Fig. 2.—A mature apple tree. Limited pruning and pendulous habit of the "Regulated" system

greater on MM 104 than on MII. In a younger planting at Luddington it also appears to be forging ahead. It is easily propagated and trees crop early. MMIII is also showing great promise, particularly as regards drought-resistance. In tree growth it is similar to MII, but in cropping is much better and is generally felt to be a good replacement for MII. MM 109 is doing quite well in trials but has no apparent advantage over MM 104 under English conditions and has the disadvantage of producing a larger tree and having poorer anchorage.

MXXV and MM 115 show some merit in the very vigorous group, but are not being used to any extent commercially. MXXV although raised with the Malling Merton series was placed in the Malling group owing to its susceptibility to woolly aphis. MM 106, which produces a tree approximately equivalent to MVII, is also not being planted very much. A more recent selection M 26 (previously known as 3436) is expected to be a suitable substitute for MIX although it is rather more vigorous.

The United Kingdom was subjected to an extended dry spell in June, and many apple trees showed leaf yellowing and some defoliation. At Luddington Experimental Station the apple rootstock trial is planted on light soil and is in the first year of grassing down, therefore, drought symptoms were more severe. Observations made early in July on Cox showed that, in terms of foliage symptoms, MMIII produced the most drought-resistant tree with little to choose between 109, 104 and 106 in the next group. MII was most seriously affected and a considerable proportion of the leaves had yellowed and dropped.

East Malling is producing quantities of the new stocks from stool beds for distribution to nurserymen and growers. Commercial plantings on the new stocks are being made, but growers still hesitate to embark on large scale usage. Some growers are making close planting of two or three stocks planted in such a way that eventually one or two stocks can be removed leaving the stock which is found to be the best.

Mr. Preston of East Malling made a number of suggestions regarding stocks

worth trying in Western Australia and these will be taken into consideration in planning rootstock trials.

All recent rootstock trials in England have been very lightly pruned and this has encouraged the expression of early cropping tendencies even to some extent on the more vigorous stocks.

Open-pollinated seedlings are considered too variable in nature, particularly as regards effect on production, to be satisfactory as apple rootstocks. An interesting exception is being demonstrated at Long Ashton. Certain apple species have been found which produce apomictic seedlings, i.e., from nucellar seeds produced without the stimulation of pollination. The resulting seedlings are therefore true to the maternal parent and uniform genetically. Two such species are known viz., *Malus sikkimensis* and *Malus toringoides* and seedling stocks from both these are under test. A few fertile seeds are produced but the resultant seedlings can be easily recognised and culled out.

PROPAGATION OF APPLE ROOTSTOCKS

Apple rootstocks are normally propagated in layer or stool beds but this is costly and takes up valuable space. The raising of clonal rootstocks from cuttings has therefore engaged the attention of research workers periodically for a number of years. Recently Garner and Hatcher at East Malling demonstrated the importance of environment in obtaining a satisfactory strike and the effect it has on the type of cutting used. As a result of this work practical methods of propagation cutting have been developed.

The main factors involved are:

1.—Source of Cuttings.

Stoolbeds have generally provided cuttings with the highest percentage "strike." Practically, however, hedgerows developed from clonal stocks are a better source of material and with suitable growing conditions will give good results. Cuttings from nursery rows as a rule give a much lower strike.

2.—Time of Taking Cuttings.

Both softwood and hardwood cuttings have been successfully used, the softwood cutting being rooted under intermittent mist. May and June cuttings proved the best and under partial shade and mist up to 100 per cent. strike was obtained. Cuttings taken at this stage have a high capacity to form roots but are very liable

Fig. 3—East Malling Research Station, Kent, England

to fail unless growing conditions are ideal. Those taken later in the summer have a lower rooting potential but a higher survival rate under slightly adverse conditions.

Hardwood cuttings may also be struck by taking them in autumn and holding them over the winter under controlled temperature conditions.

The method is to partially bury the cuttings in a well-drained mixture of sand and peat, the temperature of which is maintained above 40° F. by means of bottom heat. The soil is in a bin with sides and tops insulated with baled straw.

Fig. 4—Jonathan on Malling-Merton 104 rootstock which produces a medium-sized tree of high yielding capacity

Early in the spring the beds are gradually uncovered to harden off the cuttings before planting out. The object is to get good callous formation during the winter without root growth.

3.—Types of Cuttings.

The basal portion of the shoot provides the best striking material in the case of hardwood cuttings. Root development decreases progressively from the base to the tip of the shoot. For softwood cuttings however the tip growth roots more readily but only when growing conditions are ideal such as shaded mist propagation.

4.—Treatment of Cuttings.

Effective root promotion has been obtained by a quick dip of the cuttings in a solution of indole-3-butyric acid (½ mgn per ml. of 50 per cent. alcohol) before planting.

PLANTING SYSTEMS

Production per acre and tree size in relation to management costs are basic considerations in the economics of fruit production. This aspect of fruit-growing has been given considerable attention both by research stations and commercial growers. Trials were seen at Long Ashton and at the N.A.A.S. Experimental Station at Luddington comparing production and production costs with varying numbers of trees per acre planted and trained to different systems. Any considerable increase in the number of trees per acre is only possible by the use of temporary

fillers, dwarfing rootstocks or close planting methods using dwarf pyramids or cordons.

At Long Ashton an 11-year-old trial with Cox comparing four systems of planting was seen. Details of the treatments together with costs of planting and production figures are as follows:—

Planting System	Stock	No. of trees/ acre	Planting costs/ acre	Total Production per acre for 1st 10 years
			£ Stg.	Bus.
1. 24 ft. x 24 ft. sq.	MII	75	37	706
2. 24 ft. x 24 ft. sq.	MII	75 } 302	116	716 } 1,731
12 ft. x 12 ft. inter	MIX	227 }		1,015 }
3. 8 ft. x 3 ft. cordons	MII	1,815	696	1,737
4. 8 ft. x 4 ft. dwarf Pyramids	MII	1,361	362	2,307

The permanent trees with or without fillers in Treatments 1 and 2 respectively have yielded about the same, indicating that under these conditions competition between trees was not a factor in production. With the addition of fillers on NIX at 12 ft. spacings in both directions production per acre was increased 2½ times in the first 10 years. At this stage crowding became such a problem that two thirds of the fillers had to be removed to provide access for machinery. Dwarf pyramids at 1,361 trees per acre have given by far the greatest production (3.3 times the orthodox 24 ft. planting) although establishment costs are high. Cordons are not considered economical. Both pyramids and cordons require a great deal of detailed training and tying down, particularly during the summer, and this greatly increases the labour cost.

In commercial orchards, a number of instances of close planting were seen mainly using MIX fillers in a permanent MII planting. Generally, by this means, production per acre could be at least doubled in the early years but the need for access for spraying and harvesting usually necessitated the removal of at least some of the trees after about ten years. There was feeling among growers and field officers that close planting with a single stock may be preferable to using two stocks of different vigour. A few growers are successfully growing close planted dwarf pyramids but this is more of a novelty than a practical method. The main aim of most growers visited seemed to be to get greater production per acre even at the expense of some inconvenience in working. Plantings of 17 and 18 ft. square with fillers in the middle of the squares were seen. Tree yields under English conditions are not high and, even with interplants, production on several orchards visited was only 450-500 bushels per acre.

SOIL MANAGEMENT

Permanent grassing of orchards is now accepted as an ideal method of soil management and is widely practised in commercial plantings. Its value in facilitating spraying and other orchard activities is immediately apparent on walking through the orchards.

Grassing-down almost invariably imposes a check for a year or two on the trees' vigour. This check is most severe with strong grasses such as rye and least with clovers. The effect is worst on very young trees and also when grassing-down coincides with a dry summer. Trees on light soils may also receive a greater setback. To minimise the effect it is usual either to delay grassing down for four to five years, at which stage the trees should be well established, or else to provide a 6 ft. square of straw mulch around young trees for at least the first two years of grassing-down to enable the trees to adjust themselves gradually to the new environment. The more competitive award species such as ryegrass, while producing maximum setback of the trees, will also give the greatest improvement in fruit colour and may be used to advantage on good deep soils. S50 Timothy, the generally-recommended species, or natural tumbledown will check the trees less and are more suitable under average conditions. Clovers, while causing a briefer check to the trees, tend to die out owing to the heavy nitrogen dressings (5 cwt. per acre) which the trees must receive to counteract the induced deficiency. Once the trees overcome, the initial setback of grassing-down they rapidly improve.

Growers tend to choose the weaker grass species which are easier to cut and often rely on natural tumbledown. Mowing is a continuous operation during the summer and weekly cutting is sometimes necessary. Gang mowers are commonly used and also some rotary types.

Fig. 5—Planting system trial at Long Ashton Research Station. Orthodox 21 ft. square planting (left) compared with 21 ft. square planting with filler trees on Malling IX dwarfing stock (right)

It is very difficult to maintain the sward species in anything like a pure stand and the final result is usually a mixture of grasses with a high proportion of natural species.

In a trial at East Malling comparing permanent grass, straw mulch and clean cultivation at 14 years, trees grown with a straw mulch have produced the largest trees and greatest yields. The fruit however, has proved inferior in colour and storage quality to other treatments. Under clean cultivation the trees are the smallest, and are now showing stoppage of leaders and general lack of vigour.

NUTRITION

Long term experimentation with major elements on apple trees under clean cultivation conditions has shown a response, mainly to potassium, which is often nitrogen-induced. At East Malling, mature apple trees receiving no fertiliser over a period of nearly 20 years were at least equal in performance to those receiving various major element combinations. As soon as the orchard is grassed-down, however, nitrogen becomes limiting. It is usual to apply 5 cwts. of sulphate of ammonia and 1 to 2 cwts. of potash per acre.

Storage trials carried out at the Ditton Laboratories with Cox from the soil management trials at East Malling showed the best storage quality fruit comes from grassed plots and appears to be related to low nitrogen and high phosphate in the fruit. High K and low N gave no improvement in quality while high N under clean cultivation or straw mulch gave the poorest quality in terms of rots and breakdown.

Magnesium.

A very decided increase in yield (up to 100 per cent.) was obtained with close planted apple pyramids by the application of several foliage sprays of 2 per cent. magnesium sulphate during the early growing period.

Trace Elements.

Although copper and zinc are not seriouly deficient as a rule in English orchards, experience at Long Ashton has

shown that a greater response is obtained with a 0.1 per cent. spring spray of zinc sulphate without lime than a 4 per cent. dormant spray. Similarly 0.05 per cent. straight bluestone as a foliage spray is preferred to a stronger Bordeaux mixture.

At Long Ashton it has been demonstrated that molbydenum deficiency inhibits the nitrifying process of bacteria in legumes. This is of interest in connection with the relationship of molybdenum to nodulation.

IRRIGATION

Considerable interest is being shown at present in the effects of irrigation on apples, and numbers of growers have installed irrigation plants particularly in the western fruit areas.

Trials being carried out at East Malling have clearly demonstrated the benefits of maintaining adequate summer soil moisture on tree growth, yield and fruit size, although the trees normally show no severe stress. Water was applied to maintain soil moisture at specific tensions viz., 10, 20 and 50 cms. of mercury during the summer months. Tensiometers were located under each tree.

Applications at 10 cms. tension gave improved tree growth and considerable increase in yields due to increased fruit numbers and improved size. Irrigation at 20 cms. produced less effect on tree growth and yield. At 50 cms. the effect was mainly on fruit size resulting in slightly better yields than no irrigation.

SPRAYING

Low-volume spraying is widely practised with air blast equipment and increased concentration. Dr. Morgan at Long Ashton is carrying out work on droplet size and distribution and is of the opinion that it is not necessary to use concentrate sprays with low-volume application provided the spray is efficiently distributed over the plant parts to be protected. This is considered to be a function of droplet size which in turn is related to air speed and design of discharge nozzle. He felt that any increased effect with higher concentrations was probably due to the increased concentration of wetting agent. Two

Fig. 6—Dwarf pyramid apple trees on Malling IX stock planted 4 ft. apart in rows 8 ft. apart, Long Ashton Research Station

machines are under investigation. One uses air at 20,000 cu. ft. per minute (cf turbomist at 4,000 cu. ft. per minute) and a hydraulic pressure at the nozzle of 75 lb. per sq. inch. The other works with an airstream at approximately 200 m.p.h. the spray being picked up from a special arrangement of spiral rotating vanes. Dr. Morgan's views on spraying were not generally held at other centres.

At the National Institute of Agricultural Engineering at Silsoe a low-volume spray machine has been developed to operate as a power-take-off unit attached to a light tractor. It incorporates a special non-blocking nozzle arrangement and swivel V-belt drive to facilitate short turns. Concentrate sprays successfully used in the machine include wettable sulphur at 14 lb. per 10 gallons, arsenate of lead, captan, DDT and BHC.

Dr. Martin at Long Ashton has demonstrated the translocation of mercury from sprayed foliage to shoots developed subsequent to spraying.

VIRUS

The main recognised viruses of apples in the U.K. are mosaic, rubberywood, chat fruit and stem pitting.

Mosaic does not produce serious leaf syptoms in England but is considered to reduce yields. Its method of transmission is unknown, the only vector considered at all likely being the nematode. There is no direct evidence of nematode transmission but tests are in progress. Transmission of the fan leaf virus by *Xiphinema* spp. in grapevines has been demonstrated in California and it is understood that since leaving England virus transmission has been effected on peaches. The possibility of jassids being involved was thought to be unlikely.

Rubberywood is no longer a serious problem, as only certain varieties show the symptoms and selections of virus-free stocks and scions are available for propagation.

The stem-pitting virus with associated symptoms of bark-splitting and bark necrosis shows up seriously on Virginia Crab and also *Malus platycarpa*. By using the later as an indicator the virus has been located in other apple material but its significance is now known.

The chat fruit virus is not a problem as far as could be determined. A line pattern developed in *Malus platycarpa* is thought to be a manifestation of this virus.

Some of the Malling series of apple rootstocks have been found to be virus-infected. As a result of intensive selection and indexing at East Malling virus-free clones are now available of most of this series. The Mallin-Merton series appears free. It is known that virus-infected clones show reduced vigour in the nursery and the production of off-shoots in layer or stool beds is affected. In many areas recent plantings on MII were thought to be making poorer trees than previously and this may be related to virus infection.

Virus Indexing.

Indexing is carried out usually by double budding. A seedling is budded with the test bud and the indicator bud inserted just above. The indicator bud is allowed to develop and, if virus freedom is indicated, the stock can be cut off above the test bud to allow it to form a tree.

Indicators normally used are:—

Lord Lambourne—for mosaic and rubberywood.

Malus Platycarpa—for stem pitting and also for chat fruit which is thought to show as a line pattern.

Heat Treatment for Virus Suppression.

Work is in progress to produce virus-free material of apple stocks and scions by use of a heat cabinet. The method depends on the fact that at high temperatures virus multiplication is suppressed whereas plant growth is accelerated. The temperature is fairly critical between 36 and 37°C. Above 37°C plant growth is suppressed. The material for treatment is grown in a special double glass-walled constant temperature cabinet for six weeks. After this time, the tip growth and first two or three buds are usually growing ahead of the virus and may be used for grafting on to an apple seedling to produce virus-free material. A cleft graft is used and the whole graft covered with a polythene bag until the union is complete. The resultant material is then reindexed.

Fig. 7—Pruning trial at East Malling Research Station. Comparing "Delayed Open Centre" (left) with the "Regulated" system (centre) and "Open Centre Vase" (right)

NEMATODES AND THE REPLANT PROBLEM

A replant problem is recognised in the United Kingdom although it is not of any great commercial significance. An interesting effect was noted at East Malling in recent years. An old nursery site laid out previously with rows of apple and plum stool beds was allowed to revert to grass for five years and then used again for apple and plum stocks planted at right angles to the original rows. Where apple rows crossed original apple stool beds there was a suppression of growth and similarly with plums over plum stool beds.

Dr. Pitcher felt that the replant problem is a complex one with nematodes only one factor. Experiments conducted with heat treatment of soil showed that heating soil from an old orchard to 60°C resulted in much improved growth of apple seedlings planted in it. However, a similar treatment of nematode-free virgin soil also gave improvement in growth. Nematodes are not causing concern in United Kingdom orchards although their presence is known. Counts made at East Malling have not shown any significant resistance for MM 104. Counts of 240 were obtained for MM 104 as against 300 or less for other stocks.

HERBICIDES

Dalapon is being successfully used as a suppressent for species of couch grass under apple trees at Luddington Experimental Station. The trial consists of controlling couch within the rows of apple cordons. An application of 10 lb. per acre was only slightly more effective than 5 lb. per acre but two applications of 5 lb. gave a much better kill. East Malling has recorded slight damage to apple trees from the use of dalapon.

2.4.D. ethylsulphate has proved satisfactory for the control of weeds in apple stool beds at Long Ashton. Applied at the rate of 10 lb. per acre to cultivated soil the treatment suppressed weed development for at least six weeks. Respraying was not very effective in the absence of further cultivation. Two applications proved adequate for the season. The material breaks down to 2.4.D. in the soil and as would be expected is not very effective against grasses.

DISEASES

At the present time, powdery mildew is the disease causing the apple-grower the most trouble. Lime sulphur was eliminated from the scab programme with the advent of captan some years ago and this

has allowed mildew to build up to serious proportions. The problem has become so acute in some orchards that growers are embarking on a severe pruning programme on Cox, the main variety affected, plus a reintroduction of lime sulphur in an endeavour to bring the disease under control. Karathane is being used on many orchards with success but five sprays of 1 lb. per 100 gallons at fortnightly intervals commencing at mouse ear stage are considered necessary. Trials at Luddington over a number of years have shown that Karathane produces bigger trees than lime sulphur but appears to depress yields possibly by an effect on the blossom and also encourages spider mites. Many growers still prefer lime sulphur particularly where infection is bad, and colloidal sulphur at 10 lb. per acre is still recommended. In pruning out infected wood the prunings are dropped on the ground as is not considered a source of infection.

Apple and pear scab is bing controlled by captan and thiram and sometimes early copper sprays. Organic mercuries are not being used and the opinion was expressed that because of heavy bud infection and reinfection from outside were not likely to prove satisfactory.

PESTS

Mites present the greatest problem for apple-growers in that the pest has built up resistance to practically all insecticides so far tested. There was evidence during the 1959 growing season that resistance to metasystox was established and likely to render this material ineffective.

Normally there is only one brood of codling moth in England but with the early spring and warm summer many growers were caught when a second brood of codling moth appeared.

Woolly aphis and scale insects are not problems.

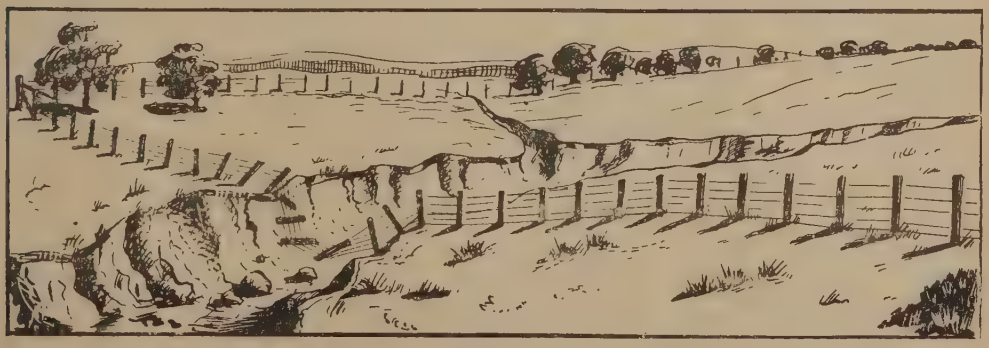
LEAF PHYSIOLOGY

Dr. Martin at Long Ashton has developed a method of cuticle separation, which entails the removal of the wax with ether, and then steeping in ammonium oxalate to dissolve the pectin layer between the cuticle and the epidermis. The cuticle is then floated off and used for observation, thickness measurement, etc. A study of cuticle thickness has revealed that it varies with nutrition and growing conditions. Leaf absorption of spray materials may be related to cuticle thickness. Pores other than those known to exist in the leaf were found in the separated cuticle. Their function is unknown.

BUD INITIATION

A method of breaking the biennial bearing cycle of apple trees has been developed at East Malling by Dr. Fulford. It consists of spraying the trees three weeks after full bloom with a 1.5 per cent. copper sulphate solution with a wetting agent. This causes heavy leaf drop (up to 50 per cent.) and is immediately followed by regrowth. This treatment applied to trees in their "off year" reduces flower bud development for the subsequent "on year" and if the right balance is struck crops can be balanced up quite well. Under hot climatic conditions this type of treatment could result in serious sunscald of the bark.

(To be continued.)



Honey Flora Calendar for July

COMPILED BY R. S. COLEMAN, APICULTURAL SECTION, WITH ASSISTANCE FROM THE BOTANICAL BRANCH

Common Name	Botanical Name	Where Found	Honey		Quality of Pollen	Remarks
			Quality	Quantity		
Karri	*Eucalyptus diversicolor*, F. Muell.	Southern coast, Denmark-Walpole, Albany	Choice	Excellent	Poor	Flowers throughout winter. Bees store some honey; depends upon weather.
Blue Mallet	*Eucalyptus gardneri*, Maiden	Great Southern	Excellent	Good	Excellent	Irregular flow, probably due to weather. Flow usually occurs at the end of its flowering period.
Warty Yate	*Eucalyptus megacornuta*, C. A. Gardn.	Ravensthorpe	Not known	Thought to be good	Unknown	Isolated species. Worked well as an ornamental.
Bullich	*Eucalyptus megacarpa*, F. Muell.	Associated with coastal and karri	Choice	Good	Good	A good build-up for karri. Too scattered to be of much value.
Fox Banksia	*Banksia sphaerocarpa*, R. Br.	Widespread	Poor	Poor	Unknown	Often in area where bees build up. Could contribute to build-up.
Holly Leaf Banksia	*Banksia ilicifolia*, R. Br.	Low areas but not swamp in coastal plain	Unknown	Uncertain	Good	Long flowering.
Menzies Banksia	*Banksia Menziesii* R. Br.	Coastal sandplain	Good	Poor to good	Unknown	Grows in association with other plants. Keeps "brood raising" going.
Bull Oak	*Casuarina fraseriana*, Mig.	Grows with jarrah and marri in coastal plain	None	None	Excellent	Bees work this tree for pollen, carrying in the whole anther and emptying the pollen sacks and then dropping them in front of the hive where they look like sawdust.
	Casuarina humilis, Otto et Dietr.	A shrub growing in many places in the South-West Division	None	None	Excellent	A very good pollen plant.
	Casuarina huegeliana, Mig.	Grows throughout the Great Southern	None	None	Excellent	A very good pollen plant.
One-Sided Bottlebrush	*Calothamnus quadrifidus*, R. Br.	Widespread	Good	Good	Excellent	Good producer in June, July, August. Good builder of strength.

Silky Blood Flower or One-sided Bottle-brush	*Calothamnus sanguineus*, Labill.	Widespread. Seems to like rocky slopes, either limestone or ironstone	Dark good quality	Excellent	Good	Flowers over a long period.
Fig-flower ; Couch Banksia ; Ground Dryandra	*Dryandra nivea*, R. Br.	Widespread. Likes clay soil	Good	Good	Good	Produces in some areas only. This may be due to soil differences. Where it produces beekeepers speak very highly of it.
	Dryandra fraseri, R. Br.	Wagin, Narrogin main area to Dongara and south in wandoo forest	Doubtful	Doubtful	Good	This plant is similar to *D. Ashbyi* and should follow approximately the same pattern.
Kerosene Bush	*Dryandra ashbyi*, Burtt.	North of Dongara	First quality ...	Good	Good	Found on ironstone and sandstone. Likes clay soil and gravelly soils best. Produces a fortnight after the opening rains.
Eggs and Bacon	*Daviesia juncea*, Sm.	Widespread	Good	Good	Good	One of the good winter-flowering plants, flowering in June-July, that hold and build up the strength of the bees.
Honey Bush	*Hakea bipinnatifida*, R. Br.	Widespread	Poor	Useful	Unknown	A showy bush as obvious from its common name, but in practice not very interesting to bees.
White Bush ; Kangaroo Bush	*Hakea trifurcata*, (Sm.) R. Br.	Widespread	Good	Good	Good	A most valuable plant, both in its timing and value in building up the bees.
	Hakea scoparia, Meissn.	Midlands, Coorow-Moora	Good	Good	Good	Good flow, sensitive to frosts. Nectar worked when it is thick.
Wild Radish	*Raphanus raphanistrum*, Linn.	A weed of wheat and other cereal crops	Good	Good	Good	Where the weather is suitable is very valuable in maintaining the strength of the colonies. Never enough for a real flow of nectar.
Tree Lucerne	*Cytisus prolifer*, Linn. f.	Cultivated plant	Good	Good	Excellent	An excellent builder of strength in the hives. Very seldom enough plants to get any honey in the hives.
Cape Weed	*Arctotheca calendula*, (L) Leugus.	Weed	Poor to good	Poor	Excellent	One of best plants for pollen.
White Clematis	*Clematis pubescens*, Hueg.	A creeper widespread through the South-West Division	Unknown	Little	Excellent	Reported frequently as an excellent pollen plant.
Geraldton Wax	*Chamaelaucum uncinatum*, Schau.	Native to coastal limestone ridges and coastal strip of Geraldton	Poor	Good	Good	Mainly an ornamental.

It will be seen from this list that information concerning many nectar-bearing plants is far from adequate. We would appreciate further information from beekeepers.

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Second WEST AUSTRALIAN RANDOM SAMPLE EGG LAYING TEST, 1958-1959

By R. H. MORRIS, B.Sc. (Agric.), Officer-in-Charge, Poultry Branch

AS part of the poultry improvement plan for Western Australia, the Department of Agriculture inaugurated a random sample laying test for commercial grade chickens at the Poultry Research Station, Herdsman Lake, in 1957.

The test, which reveals both the strong and the weak characters of laying strains available in the State, has encouraged breeders and hatcherymen to undertake poultry breeding programmes that can be expected to improve the quality of laying stock available to commercial chick buyers, but several years must necessarily elapse before the money now being spent by some hatcherymen in providing extensive poultry breeding facilities, returns dividends to the hatcherymen concerned and to the industry generally.

The results of the first test appeared in the May-June 1959, issue of the *Journal of Agriculture*.

Following are details of the second test which commenced in 1958, and closed in December, 1959.

Like the first test, the second test was well patronised, there being 27 entries in each test, and it is estimated that the hatcherymen who participate in the test sell at least 95 per cent. of the chickens sold in the State.

The first test was confined to crossbred stock but in the second test purebreds were also accepted, each hatcheryman being restricted to a single entry.

For a hatcheryman to be able to enter any particular breed, he had to sell 2,000 female chickens of the breed applied for in that year.

The 27 entries in the second test comprised 22 White Leghorn X Australorp entries, one Australorp X White Leghorn entry, two White Leghorn entries and two Australorp entries.

SAMPLING THE TEST CHICKENS AT THE HATCHERIES

Day-old chickens for the test were taken at random from the chicks offered for sale by the participants on or about August 12, 1958, over a six-day period.

Officers of the Department of Agriculture took the samples in such a way that each sample was truly representative of the stock offered for sale by the hatcheryman concerned and subsequently entered in the test.

A sample consisted of 55 sexed female chickens and when these were eight weeks old they were randomised down to 48 chickens per entry. The test officially started at this time and extended over a 10-week growing period—9 to 18 weeks inclusive, and a 50 week laying period—19 to 68 weeks inclusive. No culling was practiced throughout the duration of the test.

Entries were evaluated and ranked according to the profit returned by each bird commencing the test at eight weeks (see Table E). The profit per bird figure takes into account all the factors such as

Fig. 1.—The two rows of intensive laying pens surrounded by lawns. In all there are 120, 6 ft. x 8 ft. pens and the 48 birds from each entry occupy four of these.
The dry mash, green feed and insoluble grit are fed through the feed shute into a feed trough in each pen. The eggs are collected from outside and in front of the pens through a sliding door just above the feed shute. A continuous water trough runs along the back of the pens and a water cistern can be seen below the raised ventilation flap in the centre of the picture.

egg numbers, egg size, body weight and feed efficiency which when combined determine the economic value of a strain.

BROODING, REARING AND HOUSING

On arrival at the test site the day-old chickens were wing-banded in both wings. They were then brooded on litter with the use of a hot water system and in a brooder house which allowed ½ square foot of floor space per chicken up to the six-weeks-old stage.

There were eight brooding compartments each measuring 9 ft. x 10 ft., and, with the object of providing a uniform environment, chickens from each entry were spread evenly over four compartments.

At six weeks, one half of the chickens from each entry were transferred to a second shed which was similar to the brooder shed in construction.

Each shed was located in the centre of a fenced-off range area and the birds were allowed to range from the age of four weeks. Prior to this, the chickens had access on fine days, to small outside runs attached to each brooding compartment.

The pullets remained on range until the 18-weeks-old stage when they were transferred to the laying quarters. These consist of two lines of naturally lit, intensive deep litter sheds (see Fig. 1). In all, 120 pens, each 8 ft. x 6 ft. are provided and at 18 weeks the 48 birds from each entry were allocated at random to four of these small pens. These 12 bird groups then underwent a 50 week laying test.

FORTY-EIGHT PULLETS PER ENTRY

Officially the test did not start until the chickens were eight weeks old.

At this age any cockerels that were present owing to sexing errors were removed, and all pullets in excess of 48 per entry were balloted out.

The aim was to have each entry represented by 48 pullets at eight weeks, but if mortality in some entries was particularly high prior to eight weeks then those particular entries commenced the test with fewer than 48 pullets without being penalised in any way.

In commercial practice early chick mortality is usually not of great economic importance and as the assessment of entries in the Western Australian test is on economic grounds, it was considered advisable to disregard losses which occurred prior to eight weeks. Twenty entries commenced the test with 48 pullets each, three with 47, two with 46, and two with 44 pullets each.

EVALUATION OF ENTRIES

Entries are evaluated and ranked according to the profit returned by each bird commencing the test at eight weeks (see Table E). The value of the food eaten by each entry for the 60 weeks from the eight-weeks old stage is subtracted from the income figure (value of eggs laid plus carcass values of survivors at 68 weeks) and the gross profit figure for the entry is then divided by the number of pullets officially commencing the test at eight weeks.

(a) **Carcass Values.**—Carcass values are based on a standard price (2s. 1d.) per lb. irrespective of the bird's body weight.

(b) **Egg Values.**—Egg values are calculated on values established by the candling and grading of one day's production per week throughout the laying period.

Egg values conform with standard Egg Board gradings and values in force at that time—on a net return to producer basis.

(c) **Food Values.**—All food fed during the 50 week laying test period was weighed and valued at 3.9d. per pound. The food eaten during the rearing period (9-18 weeks) was valued at 3.5d. per pound.

As all entries were run together on range from the nine weeks to the 18-weeks-old stage, it was not possible to measure the food eaten by the birds in each entry during this period and for this figure we had to rely on one derived from a formula kindly supplied by Mr. S. T. King, of the United States Department of Agriculture.

When the body weight of the bird at the time of housing is known, the formula which includes this figure can be used to calculate the food eaten from day-old, but as our test does not start until the chickens are eight weeks old, the food eaten per bird during the first eight weeks had of course to be deducted from the calculated figure.

When a bird dies during the rearing period, the value of the food which it has eaten from the eight-weeks-old stage to time of death is debited against the entry concerned.

HEAVY LOSSES FROM AVIAN LEUCOSIS

Unlike the first test in which the incidence of disease was very light (5.78 per cent. mortality from eight weeks old to end of test), the mortality rate during the second test was excessive, no less than 547 or 43.4 per cent. of the 1,282 eight-weeks-old chickens which commenced the test dying before the conclusion of the test at 68 weeks of age. Avian leucosis was the biggest killer (see Table F) with the neural or fowl paralysis form of the disease accounting for no less than 366 or 66.9 per cent. of the total deaths. Next in importance was visceral leucosis which accounted for 81 or 14.8 per cent. of the total deaths. Leucosis in all its forms accounted for 478 or 87.4 per cent. of the total deaths.

It will be seen from Table F that the incidence of fowl paralysis reached a peak at about the time the birds were coming into production, while losses from visceral leucosis were more evident later in the year.

This disease has been getting worse in Western Australia for many years and has caused widespread hardship in the poultry industry during 1959 and 1960 with quite a number of farmers losing more than 500 birds and some up to 50 per cent. of their replacement pullets in a season.

VALUABLE INFORMATION OBTAINED

While it was most unfortunate that the test birds suffered so much from leucosis it does help to make one realise how serious the position is on isolated farms in the industry where losses from this cause have been of a similar magnitude. A test which showed no incidence of disease would certainly not be typical of conditions existing in the industry, but the incidence of leucosis in the second test was excessive.

However, despite the effect which avian leucosis had on this test, valuable data was obtained on egg production, food consumption, egg size, broodiness, rate of maturity,

bird weight, egg quality, etc., and apart from odd entries the repeatability of the entries that competed in both the first and second tests was quite good.

For example most of the entrants whose stock did well in the first test also did well in the second test. Of the ten entrants who gained above average results in the first test and who also entered the second test with the same type of stock (cross-breds) seven gained above-average results in the second test.

Also the important part played by egg production in determining the profit returned by an entry is still evident in the second test despite the high mortality, and generally speaking, those entries which had the highest egg production gained above average results in both tests. For instance, the top 14 entries in the first test had a hen-day figure, of 194.5 eggs and the bottom 13 entries 185.9 eggs. In the second test the top 14 entries averaged 180.7 eggs and the bottom 13 entries 165.3 eggs. The hen-day figure as a measure of egg production, has been used deliberately as, unlike the hen-housed figure, it makes allowance for mortality.

It will thus be seen that the second test was a valuable one in spite of the high mortality.

It is true that odd entries did very well because of the low mortality they experienced and likewise odd entries received a very low ranking because of the extremely high mortality. However, even in a test where the overall mortality is quite low, individual entries are likely to be seriously interfered with through mortality and this is one of the many reasons why too much reliance should not be placed on the results of any one particular test. Chick buyers should be more concerned with the average results achieved by their hatcherymen's stock in three or more consecutive tests, than by the results achieved in individual years. Good consistent performance is much more important than superior performance in a single test.

ENTRANTS' NAMES NOT DISCLOSED

At this early stage in the poultry improvement work it is not considered advisable to publish the names of hatcherymen who participate in the test (see first

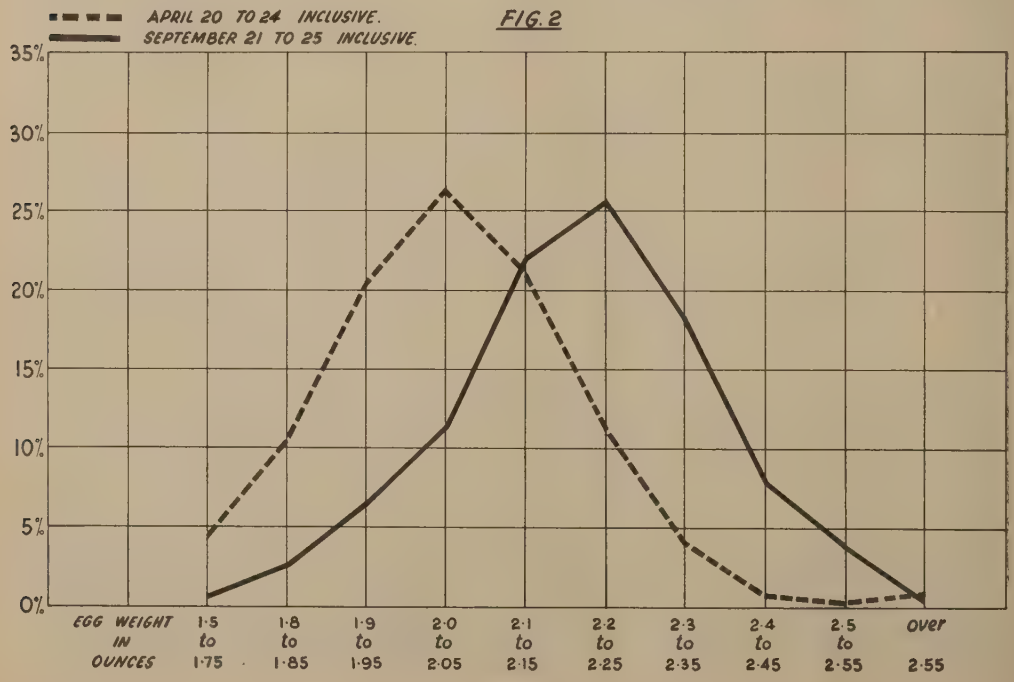

FIG. 3. DISTRIBUTION OF EGGS BY WEIGHT

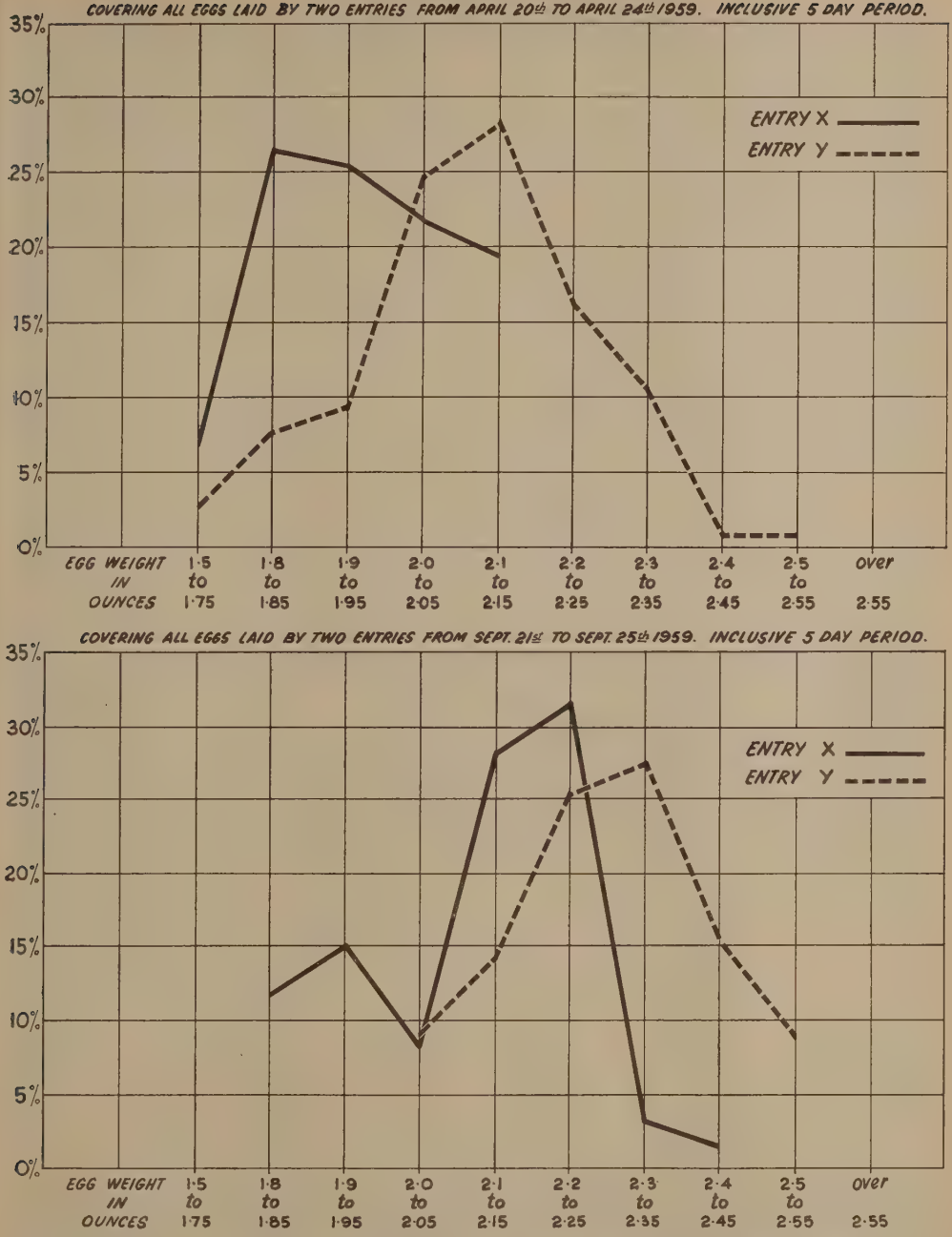

Fig. 3.—The egg size patterns for two different entries designated X and Y are given in figure 3. It will be seen that there was considerable variation in egg size between these two entries at both the early period—April—and also later in the year in September when the birds were 59 weeks of age.

Each hatcheryman is provided with the egg size pattern of his own entry together with the average pattern from all entries. He can then see at a glance whether or not, and to what extent, his fowls lay smaller or larger eggs than the average flock in the test and select for egg size accordingly, always keeping in mind, of course, the importance of egg numbers.

report for reasons). However, each entrant is given his own test result in detail together with the results which appear here and if chick buyers wish to do so, they can discuss the results with the hatcherymen concerned.

In future, reports based on average results achieved over a three-year period will be released. Entrants' names will then be disclosed and the first three-year report will cover the fourth, fifth and sixth tests. Reports will then become available annually, each report covering the three most recent tests.

EGG GRADINGS AND EGG SIZE

Egg size and egg quality have an important bearing on the result of the test and it will be seen from Table C that first quality hen eggs are graded into three grades in Western Australia. These are known as the 12 lb., 14 lb., and 16 lb. packs respectively. The grades are based on the weight of a "long hundred" of ten dozen eggs, the smallest pack containing ten dozen eggs and weighing 12 lb.

In addition to the three local grades, there are two export grades for eggs of the very highest quality and which in other respects would qualify for the 14 lb. and 16 lb. packs respectively. As an incentive for quality, an export grading carries with it a premium payment of twopence per dozen over and above the price paid for the corresponding local pack.

The 12 lb. local pack includes eggs which weigh from $1\frac{1}{2}$ oz. to less than $1\frac{3}{4}$ oz. each; the 14 lb. pack, eggs of not less than $1\frac{3}{4}$ oz. but less than 2 oz. each; and the 16 lb. pack, eggs which weigh not less than 2 oz. each. For the export 16 lb. pack, only eggs which weigh between 2 oz. and $2\frac{3}{8}$ oz. inclusive are accepted.

Average egg weight figures for each entry were determined at fortnightly intervals throughout the laying period by bulk weighing all eggs laid on a particular day.

The true average figure for the year shown in Table C, column 2, was then calculated from the fortnightly figures.

The graph (Fig. 2) showing the distribution of eggs by weight at two periods in

Fig. 4.

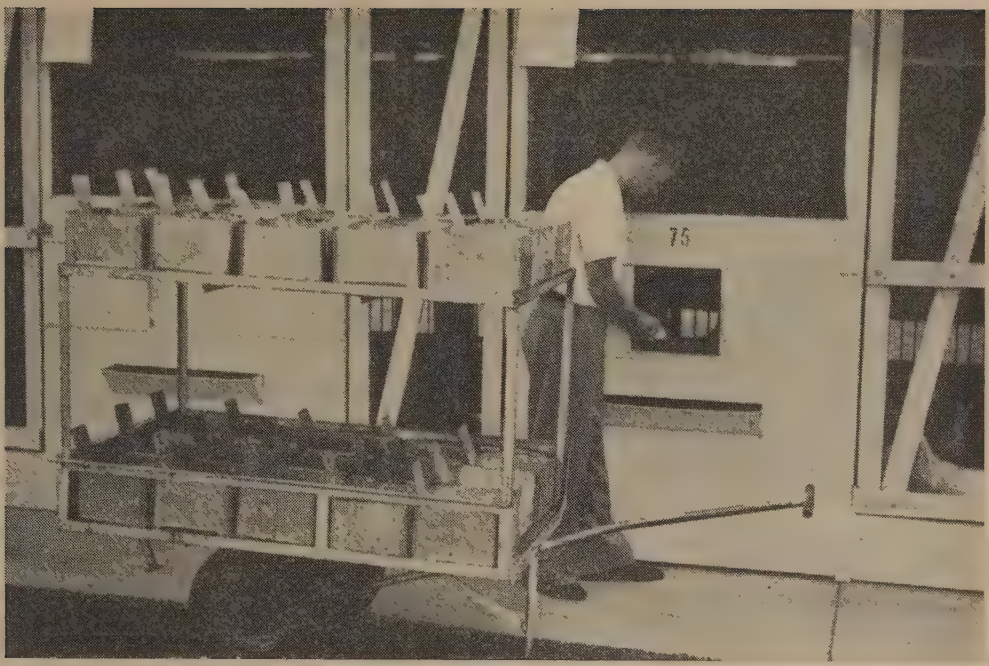

Fig. 5.

The eggs are collected in four different ways depending on the purpose for which they are required. The most frequently used method is shown in Fig. 4. Here the eggs are being collected direct into keyes fillers for market with only a record being made of the total number of eggs collected. This type of collection is made twice daily except on the following occasions.

1. One day's production every two weeks is weighed to determine the average egg weight. The identity of the eggs from each entry is preserved by placing the eggs in separate containers (see Fig. 5). The day's production from each entry is then weighed to determine the average egg weight. Approximately 22 such determinations are made for each entry each year, which means that about 12,000 eggs from all entries are weighed for this purpose.

2. Every week, one day's production from each entry is packed in cartons and taken the following day by an officer of the Department to the Western Australian Egg Marketing Board where every egg is candled and graded. In this way a net price per dozen figure is obtained for each entry. This figure is then applied to all the eggs laid by the respective entries during that week. Forty-six such determinations are made for each entry each year in order to determine the value of all eggs laid. This involves the individual collection, candling, grading and recording of about 26,000 eggs annually for all entries.

3. For five consecutive days in April and again for five consecutive days in September all eggs laid (about 6,000 for both periods) are individually weighed. From these figures graphs are compiled, typical examples being found in Figs. 2 and 3. These graphs provide each entrant with a visual picture of how the egg size of his entry compares with the average egg size of all entries at two periods in the test, namely, when the birds are 36 weeks of age and again when they are 59 weeks of age. The graphs show the proportion of the eggs which fall into the various weight ranges and therefore mean more than just an average egg weight figure. For instance an average weight of 2 oz. may mean that all the eggs weigh 2 oz. or again some may weigh 2 oz., many considerably below 2 oz. and many above 2 oz.

The patterns for egg size vary considerably between entries, as will be seen from Fig. 3.

the test shows how egg size increased as the year progressed.

The broken line relates to 3,114 eggs laid by all entries from April 20 to April 24, 1959 inclusive, i.e., during a five day period at 36 weeks of age. At this time 20.5 per cent, of all eggs laid weighed between 1.90 and 1.95 ounces inclusive, and 10.3 per cent. of the eggs weighed between 2.20 and 2.25 ounces inclusive.

Later in the year when the birds were 59 weeks of age, 2,761 eggs laid by all entries from September 21 to September 25 inclusive were weighed and it was found that only 6.7 per cent. of them weighed between 1.90 and 1.95 oz. while 25.7 per cent, of them weighed between 2.20 and 2.25 oz. inclusive.

Each entrant was provided with the egg size pattern of his own entry at the two periods in the year mentioned above, together with the average pattern of all entries. Additional data relating to egg size and contained in Table C, enables each entrant to compare the egg size of his entry with all other entries.

ALL-MASH RATIONS FED TO RANDOM SAMPLE TEST BIRDS

INGREDIENTS	CHICKEN RATIONS			LAYERS' RATIONS
	1–8 weeks	9–12 weeks	13–18 weeks	From 18 weeks
	lb.	lb.	lb.	lb.
Bran	25	25	25	20
Pollard	10	10	10	10
Finely Gristed Oats	10	10	10	10
Gristed Wheat	60	60	60	60
Whalemeal (66 per cent. protein)	5	5	4	7
Meatmeal (50 per cent. protein)	6	5	4	8
Dried Buttermilk Powder	3	2	....	....
Dried Brewers' Yeast	2	....	....	....
Bone Flour	3	3½	4	2½
Oyster Flour	....	....	....	2½
Common Salt (fine)	½	½	½	....
*Common Salt, Manganese Sulphate mixture	....	....	....	10 oz.
Manganese Sulphate	1 level teaspoon	1 level teaspoon	1 level teaspoon	....
†Synthetic Riboflavin mixture	½	....	....	....
Vitamin A and D3 Feeding Supplement	According to the Manufacturers' Recommendations			
TOTALS	125 lb. plus 1 teaspoon	121 lb. plus 1 teaspoon	117½ lb. plus 1 teaspoon	120 lb. 10 oz.
Estimated crude protein content	16 per cent.	15 per cent.	14 per cent.	16 per cent.

* The common salt, manganese sulphate mixture is obtained by mixing 4 oz. of manganese sulphate in 10 lb. of finely ground common salt. For the above layers' ration, 10 oz. of this mixture are used in every 120 lb. of mash.

† The synthetic riboflavin mixture is made by thoroughly mixing a 4 gm. packet of "Ribon" into 16 lb. of pollard, making a premix first and then gradually breaking it down with the 16 lb. of pollard.

Greenfeed: The laying birds are fed fresh kikuyu lawn clippings daily at the rate of 1½ oz. per bird. The baby chicks also received finely cut green feed which had not been fertilised with poultry manure.

Insoluble Grit: Irrespective of age, the birds always have free access to insoluble grit.

In future a coccidiostat will be included in the chicken mash for the first ten weeks.

Generally speaking, egg size cannot be regarded as a major problem in Western Australia at the present time, but as egg size can easily be sacrificed at the expense of egg numbers, breeders should strive to preserve an economic balance between these two factors in their future flock improvement work.

FEEDING

The birds were fed under the all-mash system, the rations being changed according to the age of the birds (see table).

The growing stock were dewormed twice. At 10 weeks, each bird was drenched with 1½ ccs. of carbon tetrachloride and at 17 weeks with 3ccs. of carbon-tetrachloride.

Vaccination against fowl pox was carried out at 12 weeks.

Cannibalism was effectively prevented by debeaking the birds at the time they were housed in the laying pens.

RESULTS OF FIRST AND SECOND TESTS COMPARED

Some comparisons can perhaps be made between the results of the first and second tests.

The effect which the high mortality in the second test had on total egg production and on egg production per bird on a hen-housed basis is obvious and naturally the mortality significantly lowered the monetary returns for both eggs and birds sold at the end of the test.

For instance in the first test the average return per entry for eggs was £135 15s. 8d. whereas in the second test it was only £94 11s. 6d. Likewise the average live weight value per entry for birds sold in the first test was £23 19s. 11d. but only £14 16s. 11d. in the second test. Total food consumption was also down because of the high mortality as was the profit margin per bird—the figure on which entries are ranked.

In the first test the profit per bird figure was £1 19s. for the winning entry, and £1 10s. for the entry which finished in 27th position. In the second test the winning entry had a profit per bird figure of £1 11s. 1d. and the lowest entry only 8s. 5d.

The birds in the second test weighed slightly heavier than the birds in the first test, and ate slightly more feed in the growing period but less feed per bird during the 50-week laying period. In the second test the average weight of feed consumed per bird excluding greenfeed from 18 weeks to 68 weeks of age (50 week laying period) was 86.8 lb. compared with 90.8 lb. in the first test.

The birds came into production slightly earlier in the second test, the average age at first egg being 156 days compared with 162 days in the first test. However, the average age at which a 50 per cent, rate of lay was achieved in the second test was 194 days, only one day earlier than for the first test.

The better prices ruling for eggs in Western Australia during 1959 were reflected in the second test where the average figure of 3s. 10¼d. per dozen was 2d. per dozen more than the average price obtained during the previous year. No allowance is made for cartage or freight in computing this figure but all Egg Board charges are deducted.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the staff at the Poultry Research Station and to Mr. F. A. E. Hunt for his preparation of the test results.

I am also indebted to Dr. M. R. Gardiner and Mr. I. Miller for making the post-mortem examinations of birds which died in the test, and to the Western Australian Egg Marketing Board for its co-operation in grading the eggs.

Table A

MORTALITY, BROODINESS AND BODY WEIGHT

Entries in finishing order	Breed	No. of pullet chicks officially starting test at 8 weeks of age	MORTALITY Based on number of chicks alive at 8 weeks of age				No. of birds alive at conclusion of test (68 weeks of age)	Broodiness recorded as the per cent. of birds housed at 18 weeks which were broody one or more times	Incidences of broodiness per entry	Average weight of birds in lb. at		
			9–18 weeks		19–68 weeks					18 weeks of age	35 weeks of age	68 weeks of age
			No.	Per cent.	No.	Per cent.						
1	W.L. x Aust.	48	3	6·25	10	20·8	35	11·1	10	2·97	4·75	5·49
2	W.L.	47	1	2·13	5	10·6	41	2·1	1	2·79	4·32	4·66
3	W.L. x Aust.	48	*Nil*	*Nil*	14	29·2	34	6·3	4	2·95	4·44	4·88
4	do.	48	1	2·08	14	29·2	33	2·1	1	3·06	4·79	5·42
5	do.	48	2	4·17	15	31·2	31	10·9	9	3·01	4·46	4·87
6	do.	48	*Nil*	*Nil*	19	39·5	29	4·2	3	3·16	4·78	5·21
7	do.	48	5	10·46	11	22·9	32	9·3	7	3·06	4·61	5·12
8	do.	48	3	6·25	16	33·3	29	2·2	2	3·18	4·87	5·34
9	do.	48	2	4·17	17	35·4	29	4·3	3	3·12	4·60	5·34
10	do.	48	2	4·17	18	37·5	28	4·3	2	3·04	4·51	5·07
11	do.	48	1	2·08	19	39·5	28	6·4	13	3·12	4·66	5·12
12	do.	48	4	8·33	14	29·2	30	4·5	2	3·37	5·07	5·40
13	do.	47	5	10·64	13	27·7	29	2·4	1	3·07	4·88	5·41
14	do.	46	2	4·35	15	32·6	29	*Nil*	*Nil*	3·00	4·40	4·91
15	do.	48	3	6·25	22	45·8	23	*Nil*	*Nil*	3·14	4·66	5·52
16	Aust. x W.L.	48	4	8·33	18	37·5	26	4·5	2	3·08	4·84	5·27
17	W.L. x Aust.	48	5	10·47	18	37·5	25	*Nil*	*Nil*	2·78	4·60	5·00
18	Aust.	44	*Nil*	*Nil*	17	38·6	27	13·6	9	3·72	5·44	6·37
19	W.L. x Aust.	48	3	6·25	20	41·7	25	6·7	7	2·98	4·39	4·76
20	do.	48	4	8·33	19	39·5	25	*Nil*	*Nil*	3·15	4·55	5·16
21	do.	48	8	16·66	16	23·3	24	*Nil*	*Nil*	3·15	4·89	5·42
22	do.	46	4	8·69	19	41·3	23	2·4	2	2·92	4·23	4·70
23	W.L.	47	4	8·51	16	34·0	27	2·3	1	2·89	4·62	5·44
24	W.L. x Aust.	48	4	8·33	21	43·7	23	2·2	1	3·10	4·66	5·30
25	do.	44	5	11·36	23	52·3	16	*Nil*	*Nil*	2·99	4·26	4·69
26	do.	48	6	12·5	24	50·0	18	2·3	3	2·94	4·52	5·39
27	Aust.	48	6	12·5	26	54·2	16	4·7	3	3·57	5·48	6·75
Total		1,281	87*	....	459	....	735	....	86	....	....	....
Average		47·44	....	6·78*	....	35·8	27·2	4·0	3·2	3·09	4·78	5·24

* Excluding one chicken killed accidentally at the time of deworming.

Table B

EGG PRODUCTION AND CARCASS VALUES

Entries in finishing order	Age at first egg	Age to reach 50 per cent. lay	Eggs laid by entry in 50 weeks laying period	Eggs laid per bird alive		Eggs laid per bird for 50 weeks on a hen day basis	Average egg price per dozen	Value of eggs laid to end of test based on W.A. Egg Board gradings on a net return to farmer basis	Value of birds sold at 2s. 1d. per lb. liveweight
				(a) At 8 weeks of age	(b) At 18 weeks of age				
	Days	Days					s. d.	£ s. d.	£ s. d.
1	162	195	7,405	154·0	164·6	188·2	3 11	120 16 1	20 0 0
2	165	208	7,337	156·1	159·5	168·0	3 10¼	117 17 7	19 17 11
3	153	195	7,054	147·0	147·0	177·1	3 11	112 18 0	17 5 10
4	150	198	7,130	148·5	151·7	175·3	3 10½	114 19 11	18 12 11
5	161	196	6,812	141·9	148·1	181·9	3 10½	110 6 5	15 14 7
6	147	192	6,877	143·3	143·3	196·0	3 10¼	110 10 4	15 14 7
7	150	183	6,650	138·5	154·6	187·3	3 10½	107 7 7	17 1 8
8	163	196	6,385	133·0	141·9	187·0	4 0	106 7 9	16 2 11
9	147	194	6,355	132·4	138·2	176·5	3 10¼	101 19 1	16 2 11
10	147	190	6,650	138·5	144·6	173·4	3 10¼	106 18 9	14 15 10
11	150	197	6,584	137·2	140·1	174·1	3 11	107 5 5	14 19 0
12	159	189	6,327	131·8	143·6	186·6	3 10½	102 2 10	16 17 6
13	161	192	6,136	130·8	146·1	183·8	3 9½	97 2 4	16 7 1
14	168	194	6,033	131·2	137·1	174·8	3 9	94 7 2	14 16 10
15	146	194	5,880	122·5	130·7	178·5	4 0	98 7 4	13 4 7
16	162	191	5,523	115·1	125·5	179·6	3 11	90 8 6	14 5 5
17	158	192	5,456	113·7	126·9	177·0	3 9¾	86 13 11	13 2 6
18	147	197	5,385	122·4	122·4	162·2	3 10½	87 1 7	17 18 4
19	158	191	5,413	112·8	120·3	165·1	3 10	86 8 0	12 7 11
20	155	201	5,412	112·7	123·0	165·8	3 9	86 6 6	13 8 9
21	161	189	5,142	107·1	128·5	174·8	3 10½	82 9 8	13 10 10
22	163	193	4,794	104·2	114·1	157·7	3 9½	75 14 3	11 5 0
23	168	210	5,105	108·6	118·7	146·4	3 10½	82 19 5	15 6 3
24	147	188	4,976	103·7	113·1	164·1	3 9¾	78 18 6	12 14 2
25	149	196	4,171	94·8	106·9	168·5	3 8½	64 17 10	7 16 3
26	156	180	4,363	90·9	103·9	164·6	3 8½	67 13 2	10 2 1
27	153	190	3,447	71·8	82·1	145·1	3 10¼	54 12 9	11 5 0
Average	156	194	5,882	124·0	133·0	174·0	3 10¼	94 11 6	14 16 11

Table C

EGG SIZE AND EGG GRADINGS

Entries in finishing order	Egg size	Egg gradings						
	Average egg weight of all eggs laid	16 lb. export	14 lb. export	16 lb. local	14 lb. local	12 lb. local	Second quality	Rejects
	oz.	%	%	%	%	%	%	%
1	2·17	60·7	23·4	6·3	*Nil*	6·3	2·9	0·4
2	2·11	54·2	29·0	5·1	0·1	8·4	2·8	0·4
3	2·08	51·3	31·1	2·8	*Nil*	10·7	3·9	0·2
4	2·13	51·2	26·8	7·9	*Nil*	9·9	3·2	1·0
5	2·11	54·1	29·3	4·2	*Nil*	9·8	2·2	0·4
6	2·11	56·6	28·8	2·6	*Nil*	8·8	3·0	0·2
7	2·11	57·9	24·1	3·9	*Nil*	10·2	3·1	0·8
8	2·16	66·9	22·0	3·8	*Nil*	4·3	2·3	0·7
9	2·19	55·6	23·7	5·7	*Nil*	11·0	3·8	0·2
10	2·09	53·9	25·0	4·2	*Nil*	12·0	4·4	0·5
11	2·13	54·5	27·2	6·8	*Nil*	7·3	4·0	0·2
12	2·12	55·6	26·6	5·1	*Nil*	8·7	3·4	0·6
13	2·07	50·6	28·5	3·6	*Nil*	13·4	2·8	1·1
14	2·05	45·3	34·1	3·8	*Nil*	13·0	3·3	0·5
15	2·13	63·8	20·1	7·5	*Nil*	7·3	0·8	0·5
16	2·14	59·6	20·6	8·5	*Nil*	8·2	2·5	0·6
17	2·08	47·1	31·4	5·0	*Nil*	12·1	4·1	0·3
18	2·16	59·0	24·4	4·1	*Nil*	8·1	3·5	0·5
19	2·08	50·3	28·3	3·3	*Nil*	15·7	1·9	0·5
20	2·08	52·8	29·7	2·2	*Nil*	11·8	2·3	1·2
21	2·10	47·3	32·6	4·6	0·1	12·6	2·8	*Nil*
22	2·04	39·8	39·0	2·8	*Nil*	16·3	2·0	0·1
23	2·24	64·3	20·9	6·2	*Nil*	5·5	1·6	1·5
24	2·07	47·7	31·8	3·8	*Nil*	13·2	2·8	0·7
25	1·99	42·9	32·2	1·0	0·2	18·8	4·4	0·5
26	2·08	42·2	30·7	4·3	*Nil*	16·8	4·9	1·1
27	2·18	53·2	24·9	7·2	*Nil*	9·2	4·3	1·2
Average	2·11	53·7	27·5	4·7	0·01	10·4	3·1	0·6

HIGHEST AND LOWEST EGG PRICES PREVAILING DURING 1959 FOR ABOVE GRADES

Price per dozen on a nett return to farmer basis							
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
	8th June to 2nd Aug.	5 0	4 5	4 10	4 3	3 7	2 1	....
	31st Aug. to 4th Oct.	3 6	2 11	3 4	2 9	2 3	10	....

Table D

FOOD CONSUMPTION

Entries in finishing Order	Weight of food consumed from 8 weeks of age, excluding greenfeed which was fed at the rate of 1½ oz. per bird per day during the laying period	Value of feed consumed from 8 weeks of age	Average weight of feed consumed per bird from 18 weeks of age, excluding greenfeed	Average food consumption per bird per day during		Feed eaten per dozen eggs laid from 18 weeks of age, excluding greenfeed	Feed eaten per lb. of eggs produced from 18 weeks of age, excluding greenfeed
				9–18 weeks (10 week period)	19–68 weeks (50-week laying period)		
	lb.	£ s. d.	lb.	oz.	oz.	lb.	lb.
1	4,136·35	66 4 1	89·7	2·90	4·10	5·72	3·51
2	4,238·02	67 18 10	84·4	2·74	3·86	6·02	3·80
3	4,020·68	64 6 6	85·7	2·89	3·92	5·81	3·72
4	4,251·45	68 0 11	87·7	2·98	4·01	6·10	3·81
5	3,796·82	60 13 10	85·3	2·94	3·90	5·62	3·56
6	3,852·68	61 10 8	91·4	3·07	4·18	5·60	3·53
7	3,767·75	60 3 1	88·6	2·97	4·05	5·68	3·59
8	3,661·14	58 8 8	88·6	3·06	4·05	5·70	3·50
9	3,664·25	58 9 10	84·3	3·02	3·85	5·73	3·62
10	3,907·54	62 9 7	91·4	2·85	4·18	5·94	3·78
11	3,946·32	63 1 4	87·5	3·03	4·00	6·03	3·78
12	3,800·59	60 13 5	92·6	3·16	4·24	5·97	3·75
13	3,575·89	57 2 5	89·2	2·97	4·08	5·83	3·77
14	3,422·93	54 13 2	82·4	2·96	3·77	5·66	3·68
15	3,462·59	55 4 5	85·9	3·08	3·93	5·78	3·61
16	3,400·18	54 4 5	90·3	2·98	4·13	6·04	3·75
17	3,146·22	50 4 1	84·4	2·75	3·86	5·70	3·65
18	3,741·04	59 13 2	92·3	3·52	4·22	6·83	4·21
19	3,270·68	52 2 10	81·4	2·92	3·72	5·91	3·78
20	3,397·26	54 3 3	84·9	3·04	3·88	6·15	3·95
21	3,212·81	51 4 0	88·6	3·02	4·05	6·08	3·87
22	2,944·73	46 18 7	78·7	2·85	3·60	5·99	3·92
23	3,618·01	58 16 9	87·2	2·84	3·99	7·16	4·25
24	3,227·15	51 8 6	86·2	3·00	3·94	6·31	4·07
25	2,530·10	40 3 9	79·6	2·92	3·64	5·68	3·81
26	2,797·87	44 9 9	83·3	2·80	3·81	6·08	3·89
27	2,873·57	45 12 0	93·6	3·35	4·28	7·72	4·44
Average	3,543·14	56 11 11	86·8	2·98	3·97	5·99	3·79

Table E

FINANCIAL SUMMARY OF RESULTS AT END OF TEST ON A PER BIRD ALIVE AT 8 WEEKS BASIS

Entries in finishing order	Breed	Value of eggs laid	Live weight value at 2s. 1d. per lb.	Income from sale of eggs and birds	Cost of feed from 8 weeks	Profit for each bird alive at 8 weeks
		£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.
1	W.L. x Aust.	2 10 4	8 4	2 18 8	1 7 7	1 11 1
2	W.L.	2 10 2	8 6	2 18 8	1 8 11	1 9 9
3	W.L. x Aust.	2 7 1	7 2	2 14 3	1 6 10	1 7 5
4	do.	2 7 11	7 9	2 15 8	1 8 4	1 7 4
5	do.	2 6 0	6 5	2 12 5	1 5 2	1 7 3
6	do.	2 6 1	6 7	2 12 8	1 5 8	1 7 0
7	do.	2 4 9	7 1	2 11 10	1 5 0	1 6 10
8	do.	2 4 4	6 9	2 11 1	1 4 4	1 6 9
9	do.	2 2 6	6 9	2 9 3	1 4 5	1 4 10
10	do.	2 4 6	6 2	2 10 8	1 6 0	1 4 8*
11	do.	2 4 8	6 3	2 10 11	1 6 3	1 4 8*
12	do.	2 2 7	7 0	2 9 7	1 5 3	1 4 4
13	do.	2 1 4	7 0	2 8 4	1 4 4	1 4 0
14	do.	2 1 0	6 6	2 7 6	1 3 9	1 3 9
15	do.	2 1 0	5 6	2 6 6	1 3 0	1 3 6
16	Aust. x W.L.	1 17 8	5 11	2 3 7	1 2 7	1 1 0
17	W.L. x Aust.	1 16 2	5 6	2 1 8	1 0 11	1 0 9
18	Aust.	1 19 7	8 1	2 7 8	1 7 1	1 0 7
19	W.L. x Aust.	1 16 0	5 2	2 1 2	1 1 9	19 5
20	do.	1 15 11	5 7	2 1 6	1 2 6	19 0
21	do.	1 14 4	5 8	2 0 0	1 1 4	18 8
22	do.	1 12 11	4 11	1 17 10	1 0 5	17 5
23	W.L.	1 15 4	6 6	2 1 10	1 5 0	16 10
24	W.L. x Aust.	1 12 10	5 3	1 18 1	1 1 6	16 7
25	do.	1 9 6	3 6	1 13 0	18 3	14 9
26	do.	1 8 2	4 2	1 12 4	18 6	13 10
27	Aust.	1 2 9	4 8	1 7 5	19 0	8 5
Average	....	1 19 10	6 3	2 6 1	1 3 10	1 2 3

Note.—The laying period was the same for all entries covering 350 days.
* Shared 10th place.

TABLE F

CAUSES OF DEATH FROM DAY-OLD TO 68 WEEKS

(10-week Intervals from 8 weeks)

Disease	0–8 weeks	9–18 weeks	19–28 weeks	29–38 weeks	39–48 weeks	49–58 weeks	59–68 weeks	Total
Bluecomb	20	2	....	....	....	....	....	22
Caecal coccidiosis	22	....	....	....	....	....	....	22
Intestinal coccidiosis	28	2	....	....	....	....	....	30
Caecal and intestinal coccidiosis	14	....	....	....	....	....	....	14
Omphalitis	19	....	....	....	....	....	....	19
Intestinal impaction	1	....	....	....	....	....	....	1
Ruptured heart	1	....	....	....	....	....	....	1
Accidental	2	1	....	....	....	....	....	3
Unknown*	35	4	....	2	....	....	12	53
Fowl paralysis	....	70	159	59	43	18	17	366
Fowl paralysis and visceral leucosis	....	4	2	10	6	2	....	24
Fowl paralysis and uraemia	....	....	....	....	....	....	1	1
Visceral leucosis	....	1	10	12	19	21	18	81
Ocular leucosis	....	....	....	....	1	....	....	1
Leucosis of ovary	....	....	....	1	....	....	....	1
Early leucotic lesions and impaction of gizzard	....	....	....	....	....	1	....	1
Tumour of leucotic origin	....	....	....	....	....	1	....	1
Visceral leucosis and gizzard impaction	....	....	....	....	....	1	....	1
Tumour (suspected neoplasm)	....	....	1	....	....	....	....	1
Chronic glossitis	....	1	....	....	....	....	....	1
Gizzard impaction	....	2	1	....	1	2	....	6
Impaction of gizzard and uraemia	....	....	....	....	....	....	1	1
Impaction of proventiculus	....	....	....	....	....	1	....	1
Fibrous constriction of large intestine	....	....	....	....	....	1	....	1
Sour crop	....	1	....	....	....	....	....	1
Uraemia	....	....	....	1	2	6	5	14
Protrusion of oviduct	....	....	....	1	1	....	2	4
Egg peritonitis	....	....	....	2	2	7	3	14
Ovarian folliculitis	....	....	....	....	....	....	1	1
Worm infestation	....	....	....	....	....	....	2	2
Total	142	88	173	88	75	61	62	689

NOTE.—The 142 chicks which died in the 0-8 weeks period represented 9.48 per cent. of the 1,498 chickens taken into the test at day old.

In addition to the 142 chicks which died during the first eight weeks 16 cockerels (1.07 per cent.) were removed at eight weeks, and 58 pullet chicks were balloted out. This left 1,282 pullet chicks to officially start the test at eight weeks.

Of these, 1,282 chickens 88 or 6.9 per cent. died during the 9-18 weeks period and 459 or 36.50 per cent. died during the 19-68 weeks period.

Included in the figure of 88 deaths for the 9-18 week old period was one chicken accidentally killed at the time of deworming. This was the only accidental death during the currency of the test.

The majority of birds included in the unknown deaths were birds which died during week-ends and which were unsuitable for pathological examination.